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VETERINARY MEDICINE

FEBRUARY 1939

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It is estimated that 2,000,000 people in this country ride horses regularly.

* * * *

Soft corn should not be fed to horses. It can be used profitably for fattening hogs when supplemented with extra quantities of tankage. When supplemented with an excess of protein feed it can be successfully used as a cattle feed.

* * * *

In spite of the steady drizzling rain, a crowd of 1,000 turned out on September 18 for the annual fall horse show sponsored by members of (Reserve) Troop F, 107th Cavalry Regiment of Barberton, Ohio.—*The National Horseman*

* * * *

Collar boils, sitfasts, curbs and spavins, as well as dental disturbances constitute a group of conditions that can be profitably treated by the veterinarian during the winter season. Numerous cases of these conditions exist in every farm community.

* * * *

The problem of disseminating the results of research is today as important as any problem requiring research. The gap between the enlightened practice of the few and the mediocre practice of the many worries all who observe it.—*Nature.*

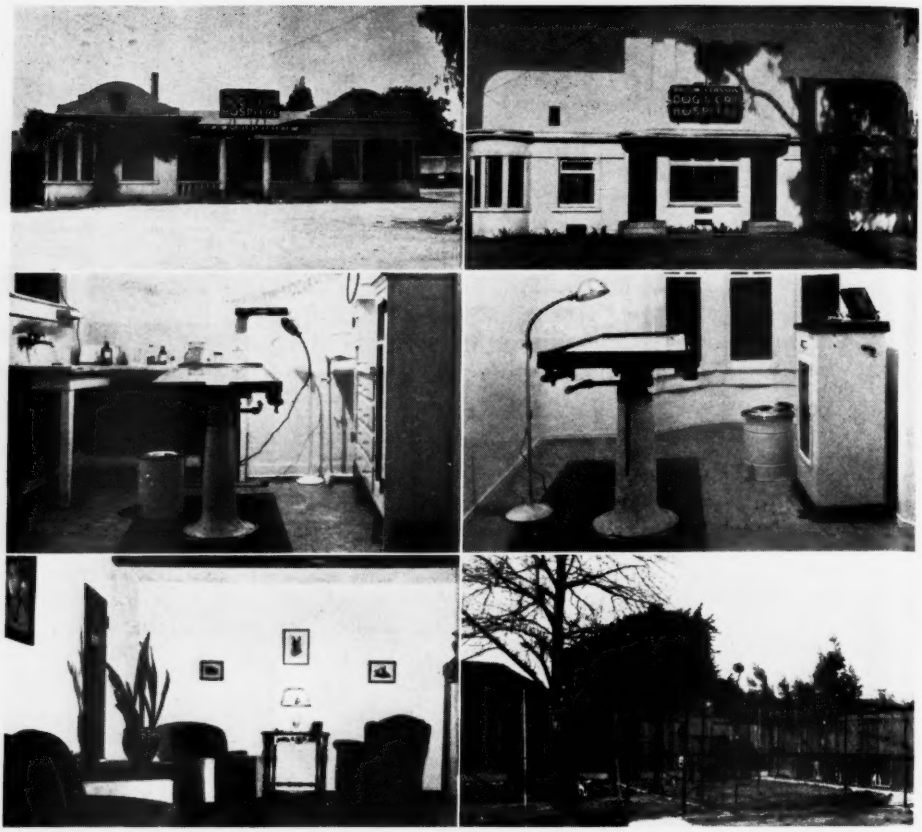
Dalldorf, Douglass and Robinson report the transmission of canine distemper to Rhesus monkeys and state that the induced disease is strikingly similar to canine distemper.—*Exp. Sta. Rec.* 79:3.

* * * *

The mortality of little pigs approximates the number of swine that is marketed. In other words, baby pig mortality depletes the swine herds by upward of 40% each year. In some sections of the country, inbreeding is being practiced. Numerous farmers are using every gilt available for breeding this year regardless of the relationship to the sire. Inbreeding is an important factor in little pig losses.

* * * *

In the United States the production of swine and the market price has varied from year to year, thus in 1923 there were 69,304,000 swine produced, with a value of $851,746,160 and in 1935, 37,007,000 swine produced, with a value of $236,000,000. The year 1935 was low from 1930 to 1935 not only in the number of swine raised, but also in their total value. The lowest price per head in the last 20 years was $4.14 in 1935, and the highest price $23.28 in 1919. Since 1900 two billion hogs worth 20 billion dollars have been produced in this country.



Dr. G. W. Closson, San Gabriel, Calif., remodeled his small animal hospital recently. The illustration at the top left is an exterior view of the building before remodeling and, at the right, the remodeled structure. At the center left is shown the old operating room, which in the remodeled structure is an examination room. In the right center is shown the new surgery into which no patients are taken except for operations; at the lower left a corner in the new waiting room, and at the right a portion of the outdoor exercise yard.

Wisconsin, always active in conservation projects, carried out, during 1938, the largest game bird propagation program in its history, producing 192,668 game birds, including several varieties of pheasants, Chukar partridge, valley quail, and wild turkeys. In addition, 10,073 breeding birds, of which 9,273 were pheasants, were planted in June and July. The conservation department is trying to increase the supply of game birds to the point where they will breed in sufficient numbers to more than offset the annual depletion during the hunting season.

The heaviest financial penalties ever imposed under the Food and Drugs Act were levied against the S. E. Massengill Company, of Bristol, Tennessee, and Kansas City, Mo. This firm pled guilty to the shipment of the adulterated and misbranded so-called Elixir of Sulfanilamide which a year ago caused the death of more than 100 persons. The Federal Court in the Eastern District of Tennessee imposed a fine of $16,800 for 112 shipments from Bristol, Tenn. A fine of $9,300 was levied by the Federal Court in the Western District of Missouri for 62 shipments from Kansas City.

There Can Be No Profit in a Diseased Animal

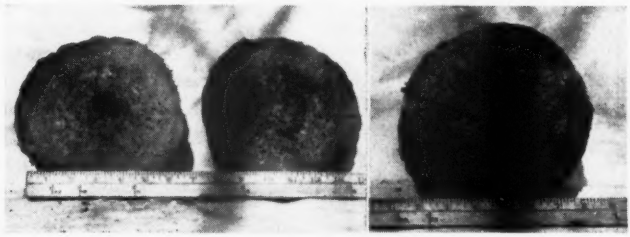
Many pay attention to conformation and production; some only to production. They leave health outside their care, and yet it is the most important. Breeding for production with ailing and constitutionally weak animals cannot last long. It will soon be competely disrupted by disease and infertility. In Germany, the aim of high yields for one or two peak periods of production in cattle has fallen into disrepute and today the desire is for prolonged production from cows. This, however, is possible only with lasting good health and good constitution, of the animals. Both health and constitution, if these are to be judged correctly, are the affair of the veterinarian, for he recognizes the criteria of a good as well as the signs of a weakened constitution; the latter being manifested by such conditions as abnormalities in bone structure, the tension or strain of tendons and ligaments, skin and hair quality, extremes in growth of long bones, by a long fine head, by a flat chest, by misshapen limbs, by puffy fetlocks and by hairless patches on ears, eyes and mouth. These are warning signs, to the veterinarian, that disaster lies ahead in that direction.—*Valentin Stang*, in *Vet. Rec.*, 50:43.

Better Not Say—

Parenteral unless you are willing to take time to pronounce distinctly each of the four syllables thus: par-en'-ter-al. This is a word one hears often these days at veterinary meetings and just about nine times out of ten the third syllable is slurred or omitted altogether, so that the word comes out to the audience "parental" and sometimes even "prental." Bungling an essential and technical word in a scientific discussion is analogous to breaking a capsule in administering it. If the speaker is unwilling to pronounce "parenteral" so that its meaning is unmistakable, he will do well to say topical, intradermal, subcutaneous, intramuscular, intraperitoneal, intravenous, intrathecal, etc., as the case may be.

Serumed.—This is an abomination all too frequently heard among veterinarians. Skill in diagnosis or in the use of instruments or medicaments is, more than anything else, the product of a trained and systematic mind, and from such a mind we do not expect such an expression as: "I serumed the hogs," "The dog was strychnined," "In temperaturing the cattle," etc. Hearers can but conclude that being careless and inept in the use of words, the speaker is also careless, indifferent and bunglesome in his practice, an impression that no veterinarian can afford to convey.

AN UNUSUAL IMPACTION



The illustration shows a bolus of fibrous material nearly as large as a football. It was taken from the colon of an 18-year-old mare. I was called to this case one evening last spring and found the mare in good flesh, with good coat, normal temperature and pulse, and only slight abdominal pain. My diagnosis was impaction of the large colon. On a return call the next morning, I found the patient much the same, but was able to locate the obstruction just anterior to the rectum. An unfavorable prognosis was given. The animal died the following day. On sawing through the bolus at the Galesburg clinic, it was found to be somewhat lamellated, as if it had been accumulating material irregularly for a long period, but it did not have a distinct nucleus or reveal any cause for its formation. Although it contained much coarse fibrous material, it included even more finely comminuted material and was very firm. A man standing on it does not change its shape. In sawing through it seemed nearly as dense as very soft wood.—*A. R. Cowser*, Farmington, Ill.

The Veterinarian's Contribution to Human Welfare*

By WILLIAM A. HAGAN, Ithaca, N. Y.,
Dean, New York State Veterinary College

THROUGHOUT the entire period of recorded history, domesticated animals have greatly influenced and advanced the life and fortunes of man. They have borne his burdens, furnished his food and provided his clothing. They have helped him to sow and harvest his crops, to flee from his enemies, and to make explorations and settlements in new places. In periods of prosperity and adversity alike, they have been man's closest and staunchest friends.

In recent years and in some parts of the world, animals, as beasts of burden, have been partially replaced by machinery. This has led many people especially those who live in cities, to believe that the function of the horse in our modern world has dwindled to the sole purpose of providing pleasure to our privileged classes on the race track, on the polo field and on the bridle path. This is far from the truth, for statistics prove that the value of horses in this country still is in excess of that of our dairy cattle and greater than the combined value of our sheep and swine; although no other country derives so large a proportion of its horsepower from machinery as ours.

As a source of food and clothing, animals and animal products continue to be as important as ever. Man is an omnivorous animal, and, while it is possible and sometimes necessary for him to subsist wholly on plant foods, he does not prefer that diet. Furthermore, in populations which are forced to live on a dietary from which animal products are absent, malnutrition and deficiency diseases usually are prevalent. The digestive system of man is not well adapted for the handling of bulky foods and is not capable of digesting a great deal of cellulose. Since the principal building material of the plant kingdom is cellulose, the nutrients in most plants are so diluted with indigestible material as to make them unavailable as human food. In general it is only the fruits and seeds that can be used, a comparatively small portion of the whole plant. On the other hand herbivorous animals, on account of the large size of their digestive canals and their ability to digest cellulose, can utilize whole plants. Their ability to convert vegetation into food suitable for man makes them tremendously important in human economy. The beginning of the practice of maintaining flocks and herds of animals on the prairies, pastures and tundras of the temperate and arctic zones marked the passage of man from a state of savagery to civilization.

Those who hear me today are among those favored few of the earth's inhabitants who are not worried greatly about the source of tomorrow's food, shelter and clothing. Through the foresight, wisdom, and good fortune of our ancestors, we were born into a state in which we can spare at least a part of our time and energy for reflection on problems which are not directly connected with life's most elementary needs. But it is still necessary, as it always has been, for a large part of the human family to apply their wits and their brawn with desperate diligence to the problem of securing the bare necessities upon which the continuation of their lives depends. Because of our favored situation, ours is the responsibility of finding ways of increasing and conserving the food supply to the end that human life may become less precarious and that health may be improved.

The Malthusian theory that man would eventually outgrow his food supply seems to be no nearer realization than it was over a century ago when it was advanced.

*Address at the 75th Annual Commencement of the Kansas State College, at which the degree of Doctor of Science was conferred on Doctor Hagan in recognition of his contributions to research and education in veterinary medicine.

Through better breeds of plants and animals, through better methods of farming which make "two blades of grass grow where there was but one before," we have been able to increase food production to meet our needs. This increased production, however, would not have been enough had we not developed means of holding in check the natural enemies of our food plants and animals. The greatest contribution of the veterinarian to human welfare lies in the protection which he has given to the animal crop against vicious enemies which otherwise would have devastated them.

■ Under conditions of domestication, disease hazards are greatly increased. When animals are collected into large herds and flocks, the spread of infections is greatly facilitated because of the intimate association of the infected and susceptible stock. When confined on small areas of ground, parasites become concentrated. When housed in dwellings where the disinfecting power of sunlight is lost, they are exposed to germs which thrive around them. Tuberculosis, for example, seldom appears in animals which lead a primitive out-of-door life, because, first, the native resistance of such animals is probably higher than that of those which live a large part of their lives indoors, and, secondly, because the disease has little opportunity to become concentrated under such conditions. In both animals and man, tuberculosis is essentially a disease of domestication; a disease of those who live in dwellings.

Time after time, in ages past, highly infective diseases have come out of their ancestral homes in the East, where they appear to slumber continuously, to ravage the animal populations of Western Europe. It has been estimated by reliable authorities that one of these diseases, rinderpest, destroyed no less than 200 millions of cattle in Europe during the 18th century. In Germany alone, more than 30 millions perished, and, in England, more than a half million were swept away in one outbreak lasting only about a year and a half. It was as a direct result of these invasions that France, Germany, Denmark, and England established the first veterinary schools. It was realized that the industries which depended upon animals and animal products could never thrive when constantly faced with such appalling disasters.

W. A. Hagan

Practically all the wealth of civilized nations has been accumulated, and most of the progress in science, invention, industry, and agriculture has been made since a competent veterinary service was developed and the great raging animal plagues of the Middle Ages banished or brought under control. Till then there was no assured food supply for anyone. Animal plagues swept whole nations and whole continents, destroying not only their food animals, but the husbandman's means of transportation and of tilling his fields. Famine was a periodic visitation on mankind.

■ During the last two hundred years veterinary schools have been established in all parts of the world where animal husbandry thrives, and these have been charged with the training of men to combat the diseases of animals. We know that the primary purpose of these schools has been accomplished because, except in a few of the less enlightened parts of the earth, the great animal plagues are seldom seen today. Scientific

research in animal pathology has made known to us the cause of most of the animal pests and the means of controlling and eradicating them. In spite of the fact that animal populations have greatly increased, the losses from disease have steadily declined.

It is highly significant that the animal diseases that are foremost in the thoughts of livestock owners today are not those which worried them most only a few years ago. Foot-and-mouth disease, contagious pleuropneumonia, dourine, and glanders have been stamped out in this country, and control measures are being effectively used against anthrax, blackleg, and hog cholera. Generally speaking it may be said that the more acute diseases, which formerly were the dread of husbandmen, are now under control, and it is the slow-moving, chronic diseases which are of most concern. Tuberculosis, Bang's disease, and bovine mastitis formerly were so overshadowed by the acute swiftly destructive diseases that it is no wonder that they were not considered seriously. Now much progress is being made with the more chronic affections. Texas fever, which once prevailed among most of our cattle south of the Mason and Dixon line, has been driven into several small areas where it is making its last stand, and bovine tuberculosis soon will be hardly more than a memory. Whereas this disease once affected more than 15% of all of the cattle of New York, and there were many areas where practically 100% were affected, the disease is now so rare that we have difficulty in finding cases to demonstrate to our veterinary students. The two diseases which are currently the center of interest to dairymen, Bang's disease and mastitis, can now be controlled, and the means await only general application. I dare say that 20 years from now these will have become of secondary interest and we shall be devoting our interest to diseases that today are receiving little attention.

■ It is impossible to estimate the economic value of these accomplishments. Diseases are spread by traffic in animals, and such traffic has never been as heavy as it is now. The careful veterinary inspections required by law for the shipment of animals in inter-state trade, the inspections at public stock yards, the inspections and detentions in the quarantine stations at ports of entry into the country, and, finally, the effective work of thousands of practicing veterinarians in every community where incipient outbreaks of highly infectious diseases are checked, all give protection to our animal population in a measure which not even our husbandmen, much less the general public, fully appreciate.

■ In spite of the great progress which has been made, however, animal diseases continue to be one of the major concerns of the livestock breeder. As soon as one disease has been conquered, nature has a way of introducing another. How they arise is a question that cannot be answered with finality. Sometimes, no doubt, these are diseases which have slumbered unnoticed in remote areas. Sometimes they are diseases which have been previously known but which suddenly take on a high degree of communicability which they previously did not possess. Sometimes they are diseases which give every appearance of having arisen *de novo*. Equine encephalomyelitis, a disease which has caused much damage in the western half of the United States in recent years, has long been known. After a long period during which the disease has been quiescent, it suddenly caused serious losses in California in 1930, and in successive years has rapidly spread to every state west of the Mississippi river. In a thriving swine raising industry which had long been established and in which the disease that we now know as hog cholera had not been known, the disease suddenly appeared in Ohio in 1833 and from there has spread throughout the world. In 1918 a new disease, now known as swine influenza, appeared in the mid-western states of this country and has since caused serious damage. There is good evidence to indicate that this infection is a form of human influenza which has become adapted to swine. Presumably it originated from the human pandemic which occurred in that year. A

disease of cattle, known as mad itch, or Aujeszky's disease, has been shown to originate from swine in which it is benign. These findings furnish a clue to the mode of origin of new diseases. They also indicate that the task of disease control is likely to be never ending.

■ An important factor which affects the animal disease situation is the great activity of livestock men in breeding for greater animal efficiency. Truly remarkable results have been obtained in this work during the last half century. We now have cows which produce nearly their own weight in butter fat, and many times their own weight in milk in a single year; hens which produce 300 or more eggs per year; sheep which produce much finer and much heavier fleeces than their ancestors. These efficiencies have been achieved by enormous development of special organs which really makes pathological specimens of the animals. A part of the price of these developments is a greater toll from disease. The constitutional vigor of such animals frequently is much reduced, and the greater activity of such organs naturally greatly increases the susceptibility to derangements and accidents. These situations create numerous new problems which must be faced by veterinarians. Without a trained personnel to handle the problem of disease it soon enters the picture, destroying the achievement of the breeder.

■ Lastly, I want to mention the important work which the profession is doing in preventing the transmission of dangerous diseases from animals to man. Anthrax, rabies, glanders, tuberculosis, tularemia, and undulant fever are the best known of these, but there are many others. When the incidence of these diseases in animals is decreased, the danger to man naturally becomes less. Furthermore, in his inspection of meat and milk, the veterinarian furnishes a protective barrier for the public. Our federal system of meat inspection is acknowledged all over the world as the finest service of its kind. More than a thousand veterinarians are employed in this work, and millions of pounds of diseased meats are condemned by them yearly. And thousands of veterinarians spend a part or all of their time making periodic examinations of milk-producing cattle in order that the public may be assured of a clean, safe, and wholesome milk supply.

■ In order that it may better be able to face the problems which lie in its field, veterinary medicine has been active in recent years in improving its educational standards. Only a generation ago it was possible for any person to qualify for admission to the profession after a year or two of special training, whether or not he had the background of a general education. This has been changed. The veterinarians who are being graduated from our schools today have had a college preparatory course in high school and at least one year of general college training before they were permitted to begin the four years of specialized training for their profession. Since the educational requirements have been above that of the general college level, the profession seems to have acquired attractiveness for young men of ability, and none of the veterinary colleges are lacking in well qualified applicants for admission. Today all of these schools are admitting students on a selective basis and this means, of course, that the quality of the manpower of the profession is rapidly improving. The old-fashioned "horse doctor" is nearly extinct, and his place is being taken by men who have had excellent educational advantages and have been thoroughly trained in the sciences which underlie modern medicine.

Although the profession in this country is quite young and has worked, until recently, under a handicap of mediocre educational advantages, it has given a reasonably good account of itself. With the higher standards of education which have been introduced recently, there is every reason to believe that a still more efficient service is becoming available. In the progress of civilization and the struggle for an assured and more abundant food supply for an ever increasing proportion of the population the veterinarian has played, and will continue to play, an important rôle.

Cryptogamic Poisoning in Horses

By H. FULSTOW, Norwalk, Ohio

A cryptogam is any one of the lower plants which have no true flowers, but propagate by means of spores. Cryptogamic poisoning in horses is caused by food or water containing poison generated by molds or bacteria.

During my 46 years in veterinary practice in a rural district where we raise a good many horses I have treated a large number suffering from cryptogamic poisoning. The sources of contaminated feed or water are many and varied, including moldy fodder, musty oats, moldy hay, spoiled ensilage, rotten cabbage leaves, or drinking water from wells or pools that were contaminated with decomposing vegetable or animal matter. Horses at pasture may contract the disease when the growth of grass is so thick that it mats together and the lower parts become moldy. Hay, especially clover hay, may become moldy if harvested from low land flooded by heavy rains just before cutting. On one occasion I saw a whole carload of fat market horses die after eating oats bought from an elevator that had been partly destroyed by fire—the oats had been water-soaked. Another time, a farmer spread in his barnyard some corn fodder that had stood out all winter, and turned his seven horses in to clean it up. Five of them died. Another farmer lost several horses from eating rotten cabbage leaves. Some of these had acute digestive trouble; others showed only cerebrospinal disturbances. Other cases developed when horses drank water from a well situated near a hog wallow; or ate hay which, because it had been rained on several times and was not fit to put in the barn, the owner had stacked outside for his horses and cattle. Along the southern shores of Lake Erie a number of horses become sick every fall from drinking water from troughs and swamps contaminated by dead June bugs; this sickness, popularly known as June bug disease, commences with diarrhea which, if not arrested, shortly develops into superpurgation and laminitis in all four feet.

These instances indicate the varying sources of the disease. It is quite common in nearly every state of the Union, as well as in England, Canada, and a great many European countries. It has been given a variety of names, including cerebrospinal meningitis, Borna sickness, botulism, forage poisoning, cryptogamic poisoning, grass staggers, etc. In Pennsylvania it was known as putrid sore throat or choking distemper. In the Middle West it is frequently called corn stalk disease. The late Dr. Leonard Pearson called it forage poisoning. Prof. Andrew Smith called it cerebrospinal meningitis. Both had many cases, which they were able in nearly every instance to trace to decomposed vegetable or animal matter in either the food or the water. Prof. James Law of Cornell University termed it cryptogamic poisoning, ascribing it to eating damaged grains, fodder, or water. Gillispe records an enzoötic of gastrointestinal indigestion with tympany among the horses of a battery of artillery in Afghanistan, caused by eating moldy grass. Frohner, Martin, and Varnell have seen cases of poisoning by molds which did not cause digestive, urinary, or febrile troubles.

In 1912 thousands of horses and mules sickened and died in Kansas and Nebraska from a disease called Kansas horse plague. Clinically it was indistinguishable from cryptogamic poisoning, but otherwise it was different. It appeared to be infectious. Within the last six or seven years thousands of horses have died each year in the western states, and some in the East, from a disease similar as far as symptoms are concerned, which has been diagnosed by Myers, Haring and others as encephalomyelitis, due to a filterable virus possibly carried by flies and mosquitos. The Kansas outbreak may have been due to the same causes.

Udall says there are many instances, especially among horses, where deaths are apparently due to ingestion of spoiled food or water, but a thorough investigation fails to reveal the essential cause. Experiments and microscopic examinations were conducted by Dr. L. R. Schwarte of the Research Institute of the Iowa State College, Ames, Iowa, to determine whether some cases that were clinically diagnosed as the virus type encephalomyelitis were not a toxic poison from moldy corn. Microscopic examinations of the brains showed no evidence whatever of the virus disease. Then five horses were placed in a dry lot and fed moldy corn and clean fodder. Three horses used as controls were fed clean corn and clean fodder. All of the horses fed moldy corn developed well-defined clinical symptoms of encephalomyelitis. The controls failed to develop any clinical symptoms whatever. According to Hutyra and Marek, bacteriological investigations of toxic encephalomyelitis have not as yet given satisfactory results and further investigation is necessary. Whatever the infective agent is, nearly all these authors agree on one point: that it is taken in either in the food or in the water, or both. Symptoms of cryptogamic poisoning, forage poisoning, botulism, Borna sickness, cerebrospinal meningitis, and encephalomyelitis are clinically alike. I arrive at a diagnosis by finding where they have been eating or drinking damaged food or water. Also by the absence of digestive trouble in virus encephalomyelitis, and the season of the year. Encephalomyelitis spreads rapidly during the summer months but with the advent of cool weather disappears.

Symptoms are very variable. Some are very nervous; others are dull and depressed, resting their heads on the manger or against the wall. They pull at the halter when tied; they are hard to lead and pull backward, and if you try to back them they push forward until they come up against the wall or fence. They climb in the manger and fall backward. They walk in circles and cannot be changed in their course unless they come up against something they can't push over. They stagger about and fall down and when down struggle about and try to get up and pound their heads on the ground. Some have paralysis of the lips with tongue hanging out of the mouth. They try to eat and drink, but are unable to swallow either food or liquids. They will stick their noses in the water and make frantic efforts to drink but are unable to do so. They sometimes will try to eat and get a mouthful of hay and just stop masticating; the food will remain in the mouth and become decomposed and very fetid. They slobber like a horse with some foreign body in the mouth but upon examination the mouth appears soft and flabby.

Loss of horses after consuming improperly-matured grain or forage has been recorded throughout the span of veterinary literature in this country. The ailment, which presents a characteristic picture, has gone by many names, but two stand out as having been used far more commonly—forage, mold, or cornstalk poisoning, and cerebrospinal meningitis; the one taken from the apparent cause, the other derived from the most characteristic symptoms and lesions. The losses from this ailment have always been large, in some years exceedingly large, but because they are widely distributed and always with us, they have attracted little public attention. In 1912 a clinically indistinguishable disease appeared panzoötically over much of Kansas and Nebraska and occasioned public hysteria, which in lesser degree has been duplicated in very recent years over infectious equine encephalomyelitis, which is also clinically indistinguishable from the non-infectious forage poisoning of hoary record. In this article Doctor Fulstow sums up nearly a half-century of experience with toxic encephalomyelitis.

Often they have a dilation of the pupils which does not respond to light. In some cases there is a marked reduction of the reflexes. The mucous membranes are generally of a dirty yellow color. Some have colicky pains with gastrointestinal disturbances, with or without tympany. They

Cornstalk Disease (Toxic Encephalomyelitis). —*Photo by Graham*

are generally constipated, passing only a few small balls of feces covered with mucus, although occasionally one may have a diarrhea. The pulse in some cases is quickened and in others sluggish. The temperature may be slightly elevated (103 to 104°F.) or it may be below normal. Some die within 24 to 48 hours and the milder cases may live a week or two and then die or recover. Post-mortem congestion of stomach and intestines usually with ecchymosis and infiltration of the sub-mucosa is common. The intestinal contents are imperfectly digested, the mesenteric glands enlarged and congested; there is inflammation of brain and spinal cord.

Treatment.— First I try to unload the bowels, usually with barium chloride, and then make the animals as comfortable as possible. To prevent abrasions and bruises from struggling and pounding their heads on the ground or against walls, I put them in a box stall or shed, tying the halter rope to a ring in the ceiling, occasionally using slings, or making a frame of rails or planks and fastening them in it. A complete change of food and water is effected. The excitable ones I bleed from the jugular vein and give sedatives. To the dumb kind I administer strychnine and potassium iodide. For both types I keep plenty of artificial Carlsbad salts or sodium hyposulphite in the drinking water. It is almost impossible to give medicine by mouth, but it is usually possible to administer it via the stomach tube, with plenty of lukewarm saline solution and stimulants. I have used calomel, creolin, salol, atropine, chloral, botulinus antitoxin. In the few cases which cannot swallow, and in which I am unable to pass the stomach tube, I inject normal saline solution with glucose or flaxseed gruel per rectum and give big doses of strychnine. If the animals have digestive troubles with tympany, I try to stop fermentation by puncturing the bowel and, after escape of the gas, injecting through the cannula a solution of either carbolic acid or creolin, following this treatment with stimulants, antiferments, laxatives, and enemas. The animals which cannot swallow usually die, although I have had an occasional recovery of such cases.

So far as I know, the only effectual method of combating this disease is by safeguarding the food and drinking water.

Horse and Mule Twins.—*Photo by C. C. Merriman*

Parasites of Domestic Animals*

By THOMAS W. M. CAMERON, Montreal, Canada.
Director of the McGill University Institute of Parasitology

THE name parasite was originally coined by the Greeks to describe those social pests who surrounded the rich men of the period; it meant "one who dines at another's table." The term has never lost this meaning although it has been extended to include a large number of animals which live on other animals but give nothing in return. This extended meaning refers to a mode of life—and when we come to consider it carefully, we find that there are probably more animals living a parasitic existence than there are free-living ones. These parasites are found in all the different branches of the animal kingdom and range from vampire bats which suck the blood of man and animals in South America to the minute creatures which cause malaria and sleeping sickness. Four of these great divisions are especially rich in parasites. The first of these includes the single-celled microscopic animalcules which cause so much damage to man and animals in the warm parts of the world. The second includes the insects, the mites, and the ticks. Many of the members of this group live on the skin or attack the host to suck his blood, although some actually pass part of their life-cycle inside the body. The most important of these are the warble-flies, the maggots of which are so commonly seen underneath the skin of our cattle. The remaining two divisions are often grouped together under the name of "worms" although they have no connection whatever with earthworms or the lugworms of the fisherman. In olden days, these worms were believed to be related to snakes and the "fiery serpent" of the Bible is one of these parasites. This old classification depended on a general resemblance in the method of movement and it has long since been abandoned. Mankind still dreads snakes, although the damage which they cause is infinitesimal compared with that produced by the true parasitic worms. These belong to two distinct groups—the roundworms and the flatworms, and these two groups cost the Dominion of Canada millions of dollars annually in losses to stock and crops.

■ Voltaire once said that mankind has only two fundamental emotions—love and hunger—and this, even if not strictly true for human beings—very neatly expresses the situation for our parasites. Each parasite is looking for a sheltered spot where it may feed and reproduce its kind in comfort and safety. Naturally it wishes to do as little harm as possible to its host; otherwise it endangers its own existence. But with the best intentions in the world, it is unable to avoid doing some damage. This may amount only to stealing some of the host's food or it may amount to actually feeding on the tissues.

To provide the continuance of the species, the parasite lays microscopic eggs. The adults have lost their ability to live a free existence: they must be parasites whether they wish or no. If these eggs developed in the same host as the parent parasite, the animal would not be able to support them all and would die from their combined attacks. So the eggs are passed out of the host to try to gain entrance to another. This in the past was an extremely difficult matter. The eggs passed in the droppings could not move far from the spot where they originally found themselves. The animal travelled over a large area of ground and so the chances of getting back were very small. Various parasites adopted different methods of overcoming this difficulty. Some laid enormous numbers of eggs —as many as ten millions a day. Others arranged for their eggs or young to be carried by flies or beetles from the manure to the food with which they were swallowed. Still others utilized blood-sucking insects to carry them from one host to another,

*Radio broadcast reprinted from *The McGill News*, Sept., 1934.

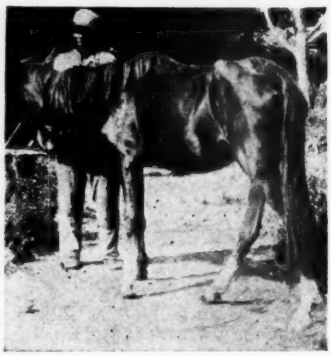
while others again underwent an enormous process of multiplication in snails and similar animals and so increased their chances of reaching the final host. The devices adopted by these parasites to pass from one animal to another provide some of the most amazing and wonderful stories of nature. As, however, in the wild state parasitism did not greatly increase—if it had it would have wiped out the entire race—it will be seen that the chances of any one egg or young parasite reaching a host were very slight—the odds against it were in the realm of millions.

■ Every known species of vertebrate animal has its parasites—usually several different kinds of parasites. They are not interchangeable to any great extent and nowadays the parasites of horses will not live in pigs, nor those of sheep in dogs, and so on. This means that they became adapted to their special hosts very long ago—long before man commenced to domesticate animals.

When this important event happened, his first step was to confine his animals. The parasite's eggs, which before had been scattered over a wide area, were now spread over a much smaller one—and so more were able to reach the host. As agricultural scince improved, these areas become smaller and smaller—permanent pastures become fashionable and parasitism became higher and higher. It is still rising and we may safely say that now farm animals as a whole suffer more from parasitic diseases than from any other cause. He who has induced two blades of grass to grow where before there was only one has incurred a very grave responsibility—he has made parasitism one of the most important things with which the farmer has to deal.

Another important development of recent times has been modern transport with the rapid transference of animals from one land to another and the introduction of new species of parasites with them. Most of the parasites in North America for example, have been introduced from Europe—but not all; and we have returned some very important species to that Continent—of which the gape worm of chickens and the nodular worm of sheep are two well known and costly examples.

■ The position is, accordingly, extremely serious and it is almost daily becoming more so—partly because agricultural science is becoming more effective, partly because we are doing nothing to keep these parasites in check, and partly because so few people even realize the danger. Every farmer knows that there are such things as parasites. He sees some of the larger tapeworms or roundworms in the droppings of his animals. But these are only the larger forms, and of the hundreds of different species of parasitic worms infesting domesticated animals and birds, most are only a fraction of an inch or so in length—and often transparent; yet they are responsible for more loss in meat, growth, wool and horsepower than any other single cause.



A result of a heavy parasitism.

They prevent young animals from growing properly and cause general unthriftiness and lack of condition. They render their hosts more susceptible to other diseases. They cause colic in horses and gapes in chickens, and lung, liver, kidney and digestive diseases in other animals: no organ escapes their depredations. Their greatest danger, however, lies in the fact that they are continually at work, sapping the strength of the animal and living at its, and the farmer's, expense. They are like an ever open tap through which the stock-owners' profits are continually dripping.

We can kill some parasites by means of drugs—but "cure" is often too late to avoid the damage—it merely stops it. Moreover all drugs which will kill parasites are more or less poisonous to the host and so their use is attended with considerable risk.

The obvious course is to prevent the parasite entering the body at all. To do this we require an accurate knowledge of what they do outside of the body. These little creatures are not governed by a thinking mind and they always react in a definite manner under any given circumstance. Their entire life is governed by chemical and physical stimuli. Once we know what these are for any given parasite, we can alter them or interfere with them in such a way that development cannot proceed. For example, the common liver-fluke must carry out part of its development outside of the sheep, in a certain kind of snail. It has no choice in the matter. If the snail is absent the parasite cannot exist and sheep cannot become infected. Killing the particular species of snail involved will certainly exterminate the disease, and with a little time and trouble, this can be done. This particular parasite, by the way, causes annual losses amounting to at least five million dollars in England alone and although we do not yet know exactly how serious it is in Canada, we know that it occurs in Quebec, the maritime provinces and British Columbia.

■ Every species of parasite has a definite life history and no two are identical. Unfortunately, of the hundreds of species occurring in domesticated animals, in less than 5%, are the life histories known, even in outline, and only a very small proportion indeed is known in detail. There are a variety of reasons for this. Parasitic worms have been known from earliest times and at one period there was a worm theory of disease. But when bacteria were discovered, the rush of enthusiasm for the new science completely eclipsed the interest in the older. The scientific world rather lost its head at this period and only recently has it recovered its sense of proportion and discovered that bacteria are not the only factors concerned in producing disease in both men and animals. In man the diseases of temperate climates have been mainly of a bacterial nature, although those in the tropics are mainly parasitic. Moreover it is much easier to grow and observe a plant such as a bacterium than it is to grow and observe an animal such as a worm. These are the main reasons for the delay in modern scientific investigation into parasitology. The opening up of the tropics started it off again and the modern interest in domesticated animals has rendered its investigation the more necessary. Veterinary and agricultural schools throughout the world are demanding that it be included in their teaching.

■ Bacterial diseases of live stock are gradually being conquered: the fight against parasitic diseases has only just begun. The actual losses due to parasites are undoubtedly greater than those due to bacteria—and they are steadily increasing. To bring parasitic diseases completely under control will demand the closest cooperation between the stock-owner, the veterinary profession and the laboratory.

* * * *

The Ever Ubiquitous Horse Trader

In the course of a three-page advertisement of his stable of trotting horses, D. B. Rice, M. D., of Britton, S. D., in the *Horseman and Fair World* for Oct. 19, 1938, tells prospective buyers, "Instead of choosing a veterinary to examine these colts, a practical horseman has been chosen to look them over and mention both good and bad." It is more than reminiscent of the old days when prospective purchasers were habitually told, "You don't need to pay no veterinary to examine this horse. He's perfectly sound in wind and limb and a willing worker. Not a pimple on him. If there was anything wrong with him I'd be the first to tell you." The wily doctor, however, avoids even a semblance of a guarantee by notifying all and sundry that another, legally incompetent to judge as to soundness, is responsible for the description of his animals.

Recent Developments in **Equine Encephalomyelitis***

By H. W. SCHOENING,
Washington, D. C.,
Chief, Pathological Division,
Bureau of Animal Industry,
U. S. Department of Agriculture

IT SEEMS desirable at this time to pay particular attention to the newer developments in research and the control of the disease that have appeared within the past year, as well as giving attention to a review of the spread of the disease during the past year and the outlook for the future.

As a result of a questionnaire sent to livestock sanitary officials of the various States, information has become available in the past three years on the incidence of the disease and its extent in this country. In 1935 there were reported about 30,000 cases; in 1936, about 7,000; while in 1937, the disease flared up and the greatest outbreak occurred that the country has ever experienced, more than 170,000 cases being reported involving 30 states with a mortality of about 25%. This year (1938) the disease has spread to nine new states, i.e., Maine, Massachusetts, Connecticut, Rhode Island in the East, and Ohio, Kentucky, Michigan, Illinois, and Washington in the West. Although 39 states reported the infection, the total number of cases reported to date is about 100,000, or 58% of that reported last year, with a mortality of about 21%. Late returns may increase this figure, but the evidence is definite that the incidence of the disease will be considerably less than last year. During this year's outbreak the causative virus was recovered for the first time from Florida, Massachusetts, Illinois, and Ohio. The data obtained thus far clearly indicate that notwithstanding the greater extent of territory involved, the case incidence and actual losses from death of animals were much lower this year than last.

At this time I would like to call attention to the fact that the incidence and continued rapid spread of encephalomyelitis in horses in the past few years have probably been without parallel in the history of infectious diseases of animals with the exception of outbreaks of foot-and-mouth disease.* We are indeed fortunate that research work vigorously undertaken at a number of institutions over a period of eight years has placed effective weapons in our hands to combat the ravages of this plague. In order to answer the question, "How can encephalomyelitis be controlled?" full information on the nature of the disease, its mode of spread, and related points must be at hand. As a result of research, much of this information has been obtained.

It has been shown experimentally that the disease can be transmitted by biting insects, such as mosquitoes and ticks, and as a result of experimentation on other methods of transmission and field studies, the theory of insect transmission, particularly by mosquitoes, is generally accepted as the way the disease is spread in nature. In order for mosquitoes to carry the virus, they must have available a source of the virus. During the early stages of an attack

*An address before the 19th Annual Meeting, Horse and Mule Association of America, Chicago, Illinois. Reprints of this paper for distribution among horse owners may be had for 3c a copy.

*This statement seems to be a result of a temporary attack of headlines. Perhaps there is saving grace in that word "parallel", but if the speaker intended, as his hearers understood, to refer to the comparative loss from animal plagues, it should be noted that the record of infectious encephalomyelitis is to that of rinderpest somewhat as a lighted tallow candle to a forest fire. Further, 70 years ago (1868) the annual loss from hog cholera passed the 10 million dollar mark, and the cost has never been less since —mostly several times this amount, or many times the highest loss from encephalomyelitis. Last year the deaths among horses in Illinois attributed to encephalomyelitis numbered 1535, and it crowded murder off the first page of newspapers. Three years ago the loss of horses from toxic encephalomyelitis, forage poisoning or blind staggers was more than three times this number, and the newspapers didn't mention it—headlines again. It seems obvious that the farmers' loss every year from disabling skeletal disease in horses greatly exceeds that from the disease under discussion in years of the worst outbreaks.—ED.

of the disease in a susceptible animal, the virus, or causative agent, is found for a short time in the blood stream. Mosquitoes sucking the blood of an animal at that time can carry the infection to other susceptible species. It has been found that a large variety of mammals and birds are susceptible to the virus of encephalomyelitis. These include beside the horse, the ox, sheep, goat, dog, rat, mouse, gopher, chicken, pigeon, duck, and vulture. During the past few months, man also has been shown to be susceptible.

We have two distinct types of the virus—the so-called eastern type and the so-called western type. Both of these viruses produce the same disease clinically, with the exception that the eastern virus perhaps is a little more severe in its action and the mortality is much greater with the eastern virus than with the western virus; but the difference between the two viruses is that they do not cross immunize.

This has a very practical application in the matter of vaccination. It is very important that the proper type of vaccine be used in an area. It would not do to use an eastern type vaccine in a territory or a country where the western virus is operating. No immunity could be expected from such a procedure. We have been paying particular attention during the past year and also in previous years to the location of the disease as it appeared in the various states, with particular reference to determining the type that was present in the state, and to date the viruses have remained quite distinct as far as this geographical location has been concerned. The western virus has remained in the West, although approaching eastward, and the eastern virus has been found along the Atlantic seaboard. This outbreak of encephalomyelitis in horses that occurred in Massachusetts in August and September of this year was of the eastern type, which is what we would expect to find.

During August and September, 1938, an outbreak of sleeping sickness occurred in Massachusetts involving the eastern and southeastern counties. Our investigation revealed the cause to be the eastern encephalomyelitis virus. At this time a number of cases of encephalomyelitis occurred in the same locality amongst children and a virus was recovered from the brains of some of the children who died. This virus was studied by the Bureau and found to be indistinguishable from the eastern equine virus in that a horse immune to eastern virus withstood an inoculation with

H. W. Schoening

From private conversations with numerous veterinarians in the thick of the 1937 and 1938 outbreaks of encephalomyelitis it seems indubitable that headline writers added at least as many casualties to the list as did the virus; i. e., that at most not more than half the reported cases were the virus disease. This exaggeration was harmful to the horse industry. As a result of veterinary research we have in the chick-embryo vaccine a highly-effective means of control of this disease. Forget the headlines. The question now is one of vaccination. We have had fly repellents and mosquito control, and about all they got us was more headlines. The judgment of the horse owner, who pays the bill or may lose the horse, and his veterinary practitioner, who knows conditions locally and must live with his mistakes if he makes them, should govern as to whether to vaccinate. Remote control is not needed.

the human virus while a normal horse and a horse immune to western type equine virus died of sleeping sickness following such inoculation.

About the same time cases of encephalomyelitis in humans were occurring in California and investigation showed that this human disease was caused by a strain of the western type equine virus.

The question of the source of the virus

Infectious Encephalomyelitis
This animal stood in this position most of the time.
—Photo by Newsom

infection in humans has by no means been settled. In the light of our present knowledge, it seems altogether probable that there is a common source of virus infection for man and animals and much less likelihood that the horse is the source of infection for man and vice versa. As has been stated, many mammals and birds are susceptible to the virus.

While it is believed that once the disease appears in horses, further spread may occur from horse to horse, there are many points to indicate that there may be a reservoir of the virus other than the horse from which biting insects may draw to start up an initial infection. The fact that the disease occurs during the insect season and subsides after killing frosts and that no cases occur until the following insect season brings up the question as to how the virus is carried over from one season to the next, and whether or not the virus exists in some carrier animal. While it is possible that the horse may be a carrier, experimental work so far has failed to indicate this. On the other hand, immune bodies are quite constantly found in the blood of the recovered horse. In addition, during the past five years large numbers of horses have been shipped from the western area, where encephalomyelitis has been epizoötic, to the East, and in no case has the western virus, which is immunologically distinct and easily differentiated by laboratory means from the eastern virus, been found in the East. Furthermore, the eastern virus has not been found in the West.

While this paper was being typed, the 25th of November, 1938, issue of *Science* came over my desk. In it there is an article of great importance in furthering our knowledge on the possible reservoirs of virus of encephalomyelitis. This article, entitled "The Occurrence in Nature of 'Equine Encephalomyelitis' in the Ring-Necked Pheasant," by Ernest Edward Tyzzer, Andrew Watson Sellards, and Byron L. Bennett[1] records the recovery of the equine virus from three pheasants received October 6, 1938, from a locality in Connecticut. The virus was found to be of the eastern equine type. There were reports that many dead, wild birds, as well as pheasants, were found following the hurricane of September 21. The birds studied were more or less paralyzed. The virus recovered from these birds was inoculated into quail and these birds were also found to be susceptible. The finding of the virus of equine encephalomyelitis in birds in nature is the first proof that we have had that this disease exists naturally in species other than the horse and man.

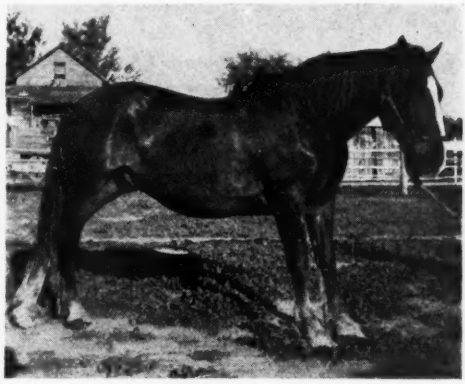
I would like to quote you the summary of this article: "The recognition of a series of cases of equine encephalomyelitis in pheasants adds valuable information concerning

[1]Department of Comparative Pathology and Tropical Medicine, Schools of Medicine and Public Health, Harvard University, Boston, Massachusetts.

the distribution of this disease, and the designation 'equine' becomes an unfortunate misnomer. Indeed, it may be seriously questioned whether the horse or other domestic animals play any essential rôle in assuring the perpetuation of this disease. The present demonstration of the natural occurrence of the infection in game birds and the experimental evidence obtained by Remlinger and Bailly of the susceptibility of migratory birds to certain strains of encephalomyelitis suggest an easy mode for the wide distribution of this virus. A search for spontaneous infection in migratory birds is indicated. Extensive surveys will be required in order to know just how widely the infection is spread in nature. It may be only under accidental circumstances or when the infection rises to a certain level that it overflows and becomes a serious problem as regards the horse and even the human being."

During October this year we received reports of the occurrence of a disease amongst wild ducks in Montana in an area where sleeping sickness was prevalent at the time. The symptoms exhibited by the ducks consisted of paralysis or weakness of the wings and legs, later prostration, and eventually death in many cases. These symptoms were suggestive of encephalomyelitis such as we had often seen in experimentally-inoculated birds and although botulism and alkali poisoning had been considered, we were still very desirous to determine whether or not the virus of sleeping sickness might be the causative agent. Accordingly, through the efforts of Dr. G. W. Cronen, we obtained a few of the dead birds and examined their brains for the presence of sleeping sickness virus. Although no virus was recovered, our pathological studies of the brains revealed alterations somewhat suggestive of those of a virus disease. It is unfortunate that the disease terminated shortly after we began our studies and further specimen material was not available. The symptoms, seasonal occurrence in a sleeping sickness area, and our pathological findings certainly are suggestive of those of encephalomyelitis. The study of this bird disease should be followed up whenever other outbreaks occur.

Measures for the control of the disease are directed along two lines, (1) the prevention of the introduction of the causative agent into a susceptible animal and (2) the raising of the resistance of the animal's body to the infection by vaccination procedures.



Typical Encephalomyelitis.—*Photo by Marsh*

Since it is generally accepted that the disease is transmitted to susceptible animals by biting insects, particularly mosquitoes, much can be accomplished by protecting animals from insects. During the past two years striking examples have been reported of the value of this method of attack in preventing losses from the disease, both in civilian establishments and the U. S. Army. Stabling horses at night in screened stables, the use of sprays, both for the destruction and repelling of insects, the use of fly nets, hoods and other measures cannot be emphasized too strongly as first line defensive measures against the disease.

Gratifying progress has been made in raising the resistance of animals to infection by vaccine therapy. This year a new type of vaccine, the so-called "chick" vaccine was developed and has had extensive use in the field. Experimentally the chick vaccine, so called because it is prepared from 9-to-12-day chick embryos that have been inoculated with the virus which is

then destroyed by formalin, has been found to be much superior to the original formolized brain tissue vaccine. The virus of encephalomyelitis, which is contained

Nervous Type of Infectious Encephalomyelitis.—*Photo by Newsom*

in the brains of animals that succumb to the disease, is rendered germ-free by passage through filters which retain bacteria, so that the resulting filtrate is sterile. This is inoculated through the egg shell. The egg is cracked and with a hypodermic needle the virus is deposited on the membranes surrounding the chick embryo. The virus multiplies very quickly in this chick embryo and destroys the embryo in from 18 to 24 hours. It has been found that a tremendous amount of virus is found in the embryo; many, many times more than has been found in the brains of animals artificially inoculated.

The chick embryos are harvested, that is, they are taken out of the shells under proper laboratory conditions. They are ground up and otherwise treated, and they are subjected then to a 0.4% formalin solution, which destroys the virus; that is, there is no active virus present in the vaccine. Prior to formolization there is a tremendous amount of virus. It has been estimated in some cases that there is ten million times more virus in the chick embryo than in the horse's brain.

Experimentally, both in laboratory animals and horses, the immunity produced by the chick vaccine has been outstanding. Animals treated with the chick vaccine can withstand very severe doses of experimental massive infection. A recent test conducted by the Bureau on horses indicated a high degree of immunity in the animals six months after vaccination with the chick vaccine. This test has just recently been completed. Six months ago we immunized three horses—this was a commercial vaccine, by the way, a commercial chick vaccine—with two injections seven days apart. Two weeks ago those animals were exposed to the virus of the disease by a direct inoculation into the brain, which is the most severe method of exposure possible. At the same time three normal horses which had been set aside six months previously with the three vaccinated horses were injected with the same material in the same manner. The result of that experiment was that the three normal horses promptly showed a rise in temperature and all the symptoms of encephalomyelitis within four days, became prostrated and died, whereas the vaccinated horses showed no rise in temperature and remained perfectly normal throughout.

This was a very outstanding case and has a considerable practical application. It indicates that an animal, as the result of vaccination, may remain resistant for at least six months' time. This is a considerable increase over the old brain tissue vaccine. That was one of the disadvantages of that particular product. It did produce some immunity, but the immunity was not as long lived as it was thought desirable. With a six-month protection possible, we also have animals on test now which we will expose perhaps three months later. which will be nine months after they have been vaccinated, or possibly a year, and we may get further information to indicate that protection may be afforded beyond the six months' period; but a six months' period would be ample from a practical standpoint to protect animals during the

time of the season when the insects would be prevalent.

A large number of horses were subjected to vaccination procedures, both before and during this year's epizoötic. For example, data now available indicate that of about 2,000 horses vaccinated with the original formolized brain tissue vaccine two weeks before the outbreak, less than 1% developed the disease. Of about the same number of horses vaccinated at the same time with the new formolized chick embryo tissue vaccine, only about 0.1% contracted sleeping sickness. Again, of about 6,000 horses vaccinated with the brain tissue vaccine during the epizoötic, about 1.5% developed the disease; while of over 30,000 horses vaccinated at the same time with the new chick vaccine, less than 0.5% developed the disease. These figures clearly indicate the value of vaccination, both before and during an outbreak, and the superiority of the new chick vaccine over the older brain tissue vaccine. However, best results from vaccination can be expected when animals are vaccinated several weeks in advance of the time when the disease might be expected to appear.

We have found that the new vaccine commercially prepared gave adequate protection in laboratory animals against all strains of virus recovered from this year's outbreak. These strains included both eastern and western types from Florida, North Carolina, Massachusetts, Illinois, Minnesota, and Kansas.

Since the disease has now disappeared for this year, it is natural that interest be directed to what might be expected next season. Just what the factors are that are responsible for the continued widespread nature of the disease are not known, but it seems probable that the disease will continue to spread into new territory unless the chain of circumstances by which it operates is broken in nature. Not knowing with our present knowledge of the disease when and if this will occur, it is a wise provision to be prepared, not only in those areas where the disease has appeared, but also in those which it has not yet touched.

With the knowledge that we now possess on the mode of spread of the disease and the degree of resistance that can be obtained with the new chick embryo tissue vaccine, weapons are at hand, if properly used, which can do much to control the spread of the disease and keep the incidence and mortality to a minimum, until such time as research throws more light on the reservoirs of the virus and opens up new avenues of attack on the problem.

All horse owners, regardless of where they are located, and particularly those that are located in areas where the disease is known to exist or is expected to appear, should take all possible precautions to protect their animals against insects. This cannot be emphasized too strongly. The disease does not occur if the virus is kept away from the animal.

It is impossible to lay down hard and fast rules for vaccination procedures, since economic problems, the status of the disease in an area, and other points must be considered. It is urged, however, that full use be made of vaccination, that the matter be discussed thoroughly with the state and local veterinary services, and that their recommendations be followed. While the new chick vaccine has been shown to be highly effective, it does not follow that every animal treated in the field will be protected. Occasional failures of the vaccine are to be expected since some individual animals may not be capable of developing appreciable immunity. Again some animals may be in the incubative stage of the disease when treated and others may receive the vaccine and become exposed a few days later before immunity has had a chance to develop. Best results are to be expected if the vaccine can be given several weeks in advance of possible exposure.

Much can be accomplished in the treatment of animals by good nursing, making them as comfortable as possible. Many worthless and quack remedies have been foisted on the public during the past several years and all efforts should be made to discourage their use.

It appears that well cared for animals are less likely to contract the disease.

Nutritional Problems in Veterinary Practice*

By KENT R. DUDLEY, Iola, Kansas

NUTRITION of animals interests me because it is so closely linked with everyday practice. It makes one feel humble to realize that the surface has been merely scratched, and that there is so much more to be learned than is known.

In the beginning we had the cow, hen and pig, just as we have them today. But selective breeding for better production and the development of concentrated feeds have made them very different animals. However, there is often a breakdown in our plans. In some instances we have overlooked some of the very simple requirements, and our oversight has resulted in malnutrition, or even disease. For this reason it behooves us to study the conditions surrounding the practical problems with which we are surrounded in our daily practices.

■ In thinking of feeds, we naturally think of their value as expressed in protein, carbohydrates, fat, etc. We sometimes forget that these feeds can be no more than the soil upon which they are grown. We must consider soils. That will make it easier to understand why we have had to make so many changes in our feeding program. It takes good soil to grow good crops, and it takes good crops to grow good cattle. Poor soil makes poor feed; poor feed makes poor cattle; and poor cattle make a poor client.

Virgin soil grows crops in abundance without treatment. Soils damaged by erosion are much the opposite. We hear much of the terrible damage done by erosion; but less is said about the soil depleted by cropping. It is an astounding fact that instead of building up the soil to grow the crops desired we have changed the crop in a far greater number of cases to suit the soil. On countless farms today the chief crops are sorghums and canes, where 20 to 30 years ago were rank stands of clover, alfalfa, or other legumes. It is well recognized among agronomists that the practice of selecting crops adapted to successive degrees of soil depletion will eventually exhaust the soil and bring agriculture to ruin. None the less the search continues for "Poor Land Clover" and "Poor Man's Alfalfa."

In the process of soil depletion there is a correlated impoverishment of the feed produced on such soils.

This condition is rapidly growing worse, and as time goes on will impose a greater penalty. Veterinarians are going to be called upon more and more to treat ailments which are due to, first, soil depletion, second, feed impoverishment, third, poor nutrition of farm animals, and lastly, manifold diseases, parasitisms, and other ailments consequent upon nutritional deficiencies.

The mineral and vitamin content of feeds have suffered most. One cannot get something for nothing, and this applies to plants grown on depleted soils as truly as in other fields of human experience.

Dr. E. V. McCarthy of Chicago, in writing on dietetics in humans, says in part:

> The most common source of error in reference to dietetic requirements of animal life lies in the mineral content of food. This is the most inconsistent factor of all, and is more often than not completely lost sight of in feeding. As an example of this, authoritative investigation has shown that certain vegetation grown under certain conditions in one section of the country assays 178.5 parts per million of iodine, as against 19.5 parts per million from another section. Another comparison is 160 parts per million of iron as against 70.5 parts per million. In processed milk the iron content varies from 0 to 127.5 parts per million, and the iodine content from 0 to 362 parts.

■ The importance of phosphorus must not be overlooked. There is a correlation of growth with phosphorus intake in animals. Calcium too is important in health and growth. Both of these elements are found in legumes. That is one of the reasons or rather two reasons for feeding legumes. But legumes can be grown on soil woefully deficient in these minerals. Grown on such

*Presented at the 33rd annual convention of the Kansas Veterinary Medical Association, Wichita, Kansas.

soils their calcium-phosphorus content is very low.

When phosphorus was applied in fertilizer to soil at the Beltsville experiment station, the phosphorus content of bluegrass was increased 25.64%, and there was an increase of 16.67% in the calcium content of the grass, although no calcium had been added to the soil. The phosphorus content of white clover was increased 22.22% in the same experiment, and the calcium content again was brought up to 11.9% without any calcium having been added. Evidently an adequate supply of available phosphorus enables the plant to utilize larger quantities of calcium. From recent experiments, this appears to hold true also in animal life. A large increase of either one of these elements alone is quite likely to bring disaster. If they are to be fed they should be fed together, in the same ratio one to the other as they occur in bone meal.

■ A rather interesting condition was found in Allen County (Kansas). It had been noticed that cattle pastured on certain ranges did not finish well; the hair coat was rough, the hide tight, there was some bone and board chewing, and evidences of lameness and rheumatism. Occasionally abortion was rampant among the animals without proper history of *B. abortus* infection. Deficiencies were noted on certain farms even though alfalfa was fed. Dairy rations high in phosphorus gave the best results; when limestone was fed the condition grew worse, and when bone meal was fed, it was corrected.

1. There is a definite ratio of calcium to phosphorus in the animal body. It is influenced by the feed.

2. Additions beyond this ratio of either calcium or phosphorus will create a deficiency of the one not added.

3. Any recommendations as far as mineral supplements are concerned must take into account the ratio of calcium and available phosphorus existing in the soil and consequently in the feed of the animals.

The foregoing conclusions were well illustrated by a recent happening to a client of mine. He had about 80 breeding cows, pasture-bred to calve in February and March. In December he asked me to vaccinate his cows for abortion. The history was that there had been no abortion the year before. The cattle were well fed, but the hair coat was rough, some were lame, and about 20 cows had aborted. After talking to him I doubted that *B. abortus* was concerned, and since there was evidence of a calcium-phosphorus deficiency, I suggested that bone meal be fed before anything else was done. The abortions stopped in about two weeks.

The following December he came to the office and told me that he had the same

In the first decade of this century, the chemist ruled supreme in nutritional matters and compounding a ration for animals was thought only to require mixing a definite proportion of proteins, carbohydrates and fats and adding "sufficient minerals". It was as simple as that. The discovery of vitamins gave nutritional research a big boost, and soon it was discovered that certain accessory food factors, not suspected earlier, were as important as the much touted proteins, carbohydrates and fats—as important as life itself. Soon came the realization that proteins differ; some are not needed, some are desirable, others are indispensable. Then came a recognition of different types of fats; some salubrious, some otherwise to certain animals. Then allergies marched on the stage to demonstrate the truth of the old adage, "One man's meat may be another man's poison." At present, most veterinarians appreciate that very many of the ailments they treat, both infectious and non-infectious, are basically dependent upon nutritional faults and that successful therapy must include an ample, well-balanced ration, as well as more specific medication.

trouble again, much worse than before, and that it could not be a mineral deficiency this time, because he was feeding a mineral. I asked what he was feeding; he cited an experiment station bulletin (published in 1919) in which prairie hay and limestone were compared to alfalfa in feeding value. He was feeding limestone. It was explained to him that what he really had was a phosphorus deficiency; that by adding limestone he made the deficiency of phosphorus greater, and hence abortion was worse. Bone meal was again fed, and the condition again corrected promptly.

Phosphorus is one of the very important elements in reproduction. Its deficiency can cause abortion and sterility. I am not belittling the presence of *B. abortus* with all its attendant troubles, but questioning the statement that all abortion is caused by that organism. In this herd a great deal of expense and trouble was saved by the simple expedient of feeding bone meal. The diagnosis in this case was made easy by knowing the condition in the locality with respect to soil depletion and hence feed deficiency. It is well to remember, however, that *B. abortus* and a mineral deficiency *may* be present in the same herd at the same time.

■ Another point that should be taken into consideration is the effect on feed values of season and weather conditions. In the Pasture Handbook of the U. S. Department of Agriculture these statements were noted:

Green, immature grasses are a much better source of minerals than hay or mature plants from the same land. Immature grass is about twice as rich in phosphates as mature, freshly cured grass, and may be about four or five times as rich in phosphates as grass that has matured and then been exposed to the weather for several months. Pasturage produced on poor land contains less than that produced on good soil. Phosphorus deficiency is more severe during droughts than during times of adequate moisture supply, regardless of stage of maturity. Lime content of grasses is usually lowest in the spring and increases as the season progresses. Livestock is able to select plants which contain relatively high percentages of minerals in preference to those that have a low percentage.

These statements may explain why there has been more evidence of deficiencies these last several years than there was before.

The *Kansas City Star* of October 2, 1936, contained an article on the need for feeding a mineral supplement. The mix suggested was bone meal, limestone and salt, equal parts. This is not meant as criticism, but rather to point out the harm that can be done by the indiscriminate recommendation of a mineral mix for a wide territory, irrespective of the conditions peculiar to given localities. This mix is all right where the phosphorus is not deficient, but where it is, it will make the condition worse. The author of this article probably had in mind the feeding of rather large amounts of cottonseed meal and bran, feeds very high in phosphorus; but due to their financial condition, the farmers in my own locality are not feeding them.

Bone chewing—osteophagia, a specific form of pica. In milder forms only the best sun-bleached bones are eaten; in aggravated forms all bones, even putrefying bones from rotting carcasses, are eaten. In extreme cases osteophagia may develop into allotriophagia when any sort of rubbish will be chewed.

■ We know very high protein ration for dairy cattle gives high production for a time, but in the end it will not only materially shorten the period of production, but it will affect the health of the animal also—and this means a financial loss to the

owner. A 16% dairy ration is considered best, when the health, production, and profit are considered over the whole producing life of the animal. There have been some "very embarrassing diagnoses" of a certain disease in sheep, when in reality it was just too much protein in the ration.

Minerals are needed to supply the mineral ingredients demanded by the animal body, if it is to work at maximum efficiency. If they are not supplied in adequate quantity in the basic ration owing to soil depletion or because a ration naturally low in minerals is being fed, a mineral supplement should be added to the feed.

It has been shown that animal protein is absolutely essential to good egg production in poultry if health and length of laying season are considered. Fat in the ration of the laying hen is also important for it is with this that the body weight is regulated and such regulation is essential to sustained production. Fat is utilized to produce heat and energy. The amount of heat needed is governed by the weather. If it be bitter cold, more fat is needed in the ration. If the weather turns warm for a time, it is obvious that this extra heat will not be used, and the hen stores the fat as an abdominal pad. This also means that her nutrition is not properly balanced. The result is that the resistance of the animal goes down and colds, certain types of roup, cholera-like conditions, loss in production and in many instances death, ensue. In treating this it is essential to correct the diet along with any medical aid. If the diet is corrected the medicinal requirements are of a temporary nature. Without correction of the diet medicinal treatment is doomed to failure or at best short-lived success.

■ This brings to mind another thing that will cause the practitioner worry. In the last several years the so-called all mash ration has been recommended. The poultryman brings his veterinarian a case that seems to present all the evidence needed for a diagnosis of too much fat in the ration. The birds are very heavy—only heavy birds affected—they are found dead under the roosts or in the nests, with combs black or deep red, very little diarrhea, and death rather sudden. Post-mortem findings indicate a cholera-like condition with a heavy pad of abdominal fat. The history is that he is feeding an all mash ration suggested by an experiment station or farm journal. This ration is complete; *i. e.*, a scratch grain in addition is not required. The fat part of the ordinary ration is found in the scratch grain, and can be regulated according to the needs. In the all mash ration this cannot be done without changing the whole balance of the feed, and that had better be done with a great deal of care if production is not to be disturbed. This is very nearly impossible for the farmer to do where he mixes up 500 to 1000 pounds of this mash at one time, and where the change has to be made in accordance with the weather conditions.

At first thought one is inclined to doubt if the ration is at fault, especially when it has been recommended by recognized authorities. But it may have been designed originally to be fed where the weather was very cold, and was being used where the weather was warm. This illustrates why rations that are used in one locality may be unsuited in another. Promiscuous acceptance of rations is to be condemned. Because they have given excellent results in one section of the country is not sufficient reason for assuming them to be correct in another locality. Since in most instances a faulty ration impairs the health of the animal and since we veterinarians are usually consulted where a condition of ill health exists, we must be vitally interested in those factors that cause this condition if we are looking toward a recovery. Uncontrolled disease can, in a week, wreck the most painstaking care of the breeder and feeder for a season or even a life time.

■ If ever there was a time when veterinarians should acquaint themselves with the facts concerning nutrition as relates to his own community, it is now. We are in a position where we can render a great service. The better we are prepared, the more valuable we shall become to the community which we shall serve.

Retained Afterbirth

By S. L. STEWART, Olathe, Kansas

THIS ailment is common in herds where Bang's disease is prevalent. White scours in calves is also common in such herds. Retained afterbirth is a symptom of an intrauterine inflammation, established before or during pregnancy, and becoming clinically recognizable only after the fetus, alive or dead, has been expelled.

The Author

When parturition ends in a healthy calf, and the umbilical cord is ruptured, the attraction between the maternal and placental cotyledons ceases. Most of the blood contained within the placental arteries, capillaries, and veins escapes from the ruptured umbilical veins. This causes a collapse of the chorionic villi, allowing them to fall out of the crypts of the maternal cotyledons. Thus a complete physiological separation of the fetal membranes from the uterus occurs and the entire mass of afterbirth is expelled without effort within a few hours after parturition.

If the afterbirth is retained, the retention is due to a pathological condition caused by infection. This disease process has been present during all, or at least during a part of, the period of pregnancy. It cannot develop after the expulsion of the fetus, alive or dead. After parturition, the afterbirth at once becomes a foreign mass of dead tissue within the uterus. If it is permitted to remain within the uterus, a toxemia or sapremia or both soon develop. It is not only good surgery but common-sense surgery to remove this foreign mass of putrefying flesh before serious absorption takes place. To fail to remove it is to invite further complications, which are a menace to the health and life of the patient.

The causes of retention of the afterbirth can be summed up in a few words. (1) Brucella infection, (2) failure to remove all the afterbirth at a previous calving, (3) flushing the uterus after removing the afterbirth, thus floating bacteria and débris into all parts of the uterus, (4) nutritional abortion, and (5) accidental abortion and premature birth.

■ The symptoms of retained afterbirth are pathognomonic, and need not be listed.

The treatment should be both preventive and curative. The immediate treatment of a retained afterbirth should be attempted in the same manner as the treatment of any other infected or inflamed areas, that is, treatment administered according to the tissues involved, the cause of the infection, and the character of the inflammation.

The first step in treating any retained fetal membranes is usually taken at the end of 24 hours following parturition, when a careful examination is made to determine the degree of uterine paresis or contraction. These symptoms should be noted carefully, as they indicate more than anything else the probable severity of the pathology and are usually a fairly good guide to immediate and later treatment. If the membranes can be detached easily, without causing severe pain to the patient, or material irritation of cotyledons or mucous membrane of the uterus, their removal should be accomplished at once, since it is only after removal of the secundines that the metritis, which caused the retention, can be treated to prevent a recurrence during the next gestation period.

In removing the afterbirth the buttocks and tail of the cow should be washed clean with soap and warm water, then covered with a mixture of aseptogen and neutral oil, 1 to 16.

The operator should cover his arms well with the same preparation, and grasp the protruding membranes with the right hand, and apply a tension on them to draw the entire mass, including the uterus, gradually back into position for detaching the membranes. If the retained fetal membranes are not strong enough to pull the

cervix well back into the posterior part of the pelvis, a 20-inch uterine forceps may be used to good advantage by fastening them deeply onto the right wall of the cervix and bringing it back almost to the vulva, when the anterior part of the afterbirth is more easily reached and detached.

As the left arm is being introduced and the membranes detached and removed, the cotyledons should first be squeezed with a slow firm pressure to relieve the congestion and reduce the size of the cotyledons, which will have a tendency to release the chorionic villi. Then while still holding the cotyledons, push the placental cotyledon away from the maternal cotyledon with a rolling movement of the thumb. This detaches the membranes with the least irritation to the maternal cotyledon. When all are detached the membranes will usually come away in a mass, but should some pieces remain, each should be removed separately.

■ After the placental membranes have all been removed, both skill and judgment are still needed in treatment. During the removal of the afterbirth, uterine contractions should increase until by the time the membranes are detached and removed the uterus will be shrunk so closely about the hand that the operation is somewhat retarded. Whether or not the uterus contracts an antiseptic capsule should be deposited deeply within the uterus before the uterine forceps are released. If the uterus is in a state of paresis, and contraction does not take place normally during the removal of the afterbirth, a 5cc dose of pituitary extract is indicated. It should be repeated in 10 to 12 hours, if necessary. A 5 to 10cc dose of metritis bacterin, or a full dose of abortion vaccine, should be given in every case.

If the patient exhibits unusual pains or if hemorrhage persists during the removal of an afterbirth, the operation should cease at once. In such cases three antiseptic capsules should be deposited deeply within the uterus, and a dose of pituitary extract and of metritis bacterin administered. This treatment is very essential. The uterine antiseptic retards in some degree the development of the bacteria, lessens decomposition, and soothes the mucous membranes, thus relieving in some measure pain and distress. The pituitary extract stimulates uterine activity, giving tone to the paretic uterine walls, and favors contraction of the uterus, which materially assists in the separation of the afterbirth. In addition, it decidedly lessens absorption of the products of decomposition within the uterus. Twenty-four hours later the membranes may be removed with safety.

All further after treatment should be symptomatic.

■ When the afterbirth has been removed, and the operator's arms well washed, an application of the following antiseptic solution should be used as a safeguard against infection.

℞

Rubbing alcohol	1 pt
Glycerine	½ oz.
Coloring & perfume to suit	

M.
Sig. Shake well and apply.

The use of this wash after the operation and the aseptogen before it will prevent the papular rash that commonly develops on the arms as a consequence of manipulations within an infected uterus.

For uterine capsules, a No. 13 gelatin capsule filled with boric acid is recommended for the ordinary case of retained afterbirth. A No. 13 capsule filled with bicarbonate of soda for the very acid afterbirths, those in which the uterine secretions seem to burn the arm while removing the afterbirth. One, two, or three capsules

When parturition is complicated by retention of the afterbirth, expert handling is necessary in order to preserve the breeding capacity of the animal. Doctor Stewart, who has had a large experience in bovine obstetrics, offers suggestions for the treatment of such cases, and warns against methods of handling that may save the life of the cow but destroy her capacity for breeding.

of either may be used, but boric acid and soda should not be used together, as they are incompatible.

There is no service a veterinarian can render a client that is of more value than the proper removal of an afterbirth and the proper care and treatment of the cow following the removal. Proper treatment will nearly always conserve the full usefulness of the animal. Neglect or improper treatment ordinarily results in sterility and sometimes in the death of the cow.

Unusual Bovine Monster

August 23, 1938, I was called to attend a cow which was having a difficult labor. The cow, a five-year old grade Holstein

and Guernsey, had been in labor two hours when I arrived. Examination disclosed two pairs of hind legs, attached at the hips, with a fifth rudimentary leg between them. I was also able to palpate a tail about three inches long between the two pairs of hips. No head could be located, but the intestines were found free in the fetal placenta.

Thinking that I was dealing with a six-legged schistocormus, I performed a cesarian section as the only means of effecting delivery.

The fetus weighed about 75 pounds and was well-haired, delivery having been at full term. It possessed the following characteristics, some of which may be identified in the accompanying illustration:

Two normal heads.
Two normal fore-legs.
Four normal hind-legs.
One rudimentary hind-leg (8 inches long, hoof fused).
Two normally-shaped rumps.
One rudimentary tail (fused) between the two rumps.
Necks fused about half-way to shoulders.
No ani. Rectums ended in blind pouches.
Opening in ventral surface of abdomen, 8 by 12 inches, much as in a schistocormus.
One liver, composed of but one large lobe.
One heart, with two anterior aortæ.
One esophagus, to right head only.
Two tracheæ.
Four scrotal sacs.
Two rudimentary penises.
Two kidneys, normally lobulated.
No urinary nor hepatic bladders.
A well-developed uterus, approximately 12 inches long, in the right pelvis, but no ovaries.
No testes.

Upon first examination it was thought that the legs were felt actively contracted by the fetus, but this may have been caused by some movement of the dam.

This monster has been mounted in an upright position, standing on the six fully developed legs. DANIEL P. EHLERS.
Butler, Pa.

Manganese Deficiency

Perosis, or slipped tendons, in chicks, definitely is linked with a deficiency of manganese, caused either directly by an insufficiency of this element in the ration, or indirectly by the interference of certain mineral supplements which reduced its availability. . . .

The minimum manganese requirement for chicks was determined to be approximately 40mg per kg of ration, but excess mineral necessitates higher levels. . . . .

Many compounds and ores of manganese were used as sources of this element and, with the exception of rhodonite and rhodochrosite, were satisfactory; the oxide ores of manganese were the most economical.—*Mich. Tech. Bul. No. 159.*

Brucella Infection in the Bull*

An account is given of studies on Brucella infection in the genitals of the bull, with a special view to the epidemiological significance of this localization.

Theoretically we have to reckon with two possible ways in which the bull may transmit the Brucella infection to the cow through copulation. The infection may be transmitted when the prepuce and penis of the bull have been soiled with exudate containing abortus bacilli (for example, in a preceding covering of a cow with bacteria-containing vaginal discharge after infectious abortion), or when the sperm contains abortus bacilli owing to processes of brucellosis in the genitals of the bull.

As under normal control conditions the aborting cows are not allowed to be covered until the vaginal discharge has ceased and the abortus bacilli thus have disappeared from the vagina, the practical chances of the first-mentioned possibility ("passive" transfer of infectious material) cannot be great even though they must be said to be present under certain conditions—for instance, when the bulls are moving about freely among the cows in herds. Of far greater interest, we think, is the question about the possible role of the bull in active spreading of the infection.

In order to throw some light on the question as to what extent bulls with Brucella infection of the genitals produce infected sperm, in the last two years this laboratory has investigated the cases of altogether 12 bulls with abortus infection of the testicles. These bulls were purchased in various parts of the country for the Medical Clinic of the Royal Veterinary College, where the animals were under observation for some length of time before they were killed. The autopsy included a thorough examination for the presence of abortus bacilli.

Specimens of semen were collected by means of a so-called artificial vagina of the same type as is used in this country for the performance of artificial fertilization. This apparatus can be disinfected easily. In this way it was practicable to obtain specimens of semen sufficiently "pure" to allow of bacteriological examination by means of cultures on serum agar plates and by inoculation of guinea-pigs.

Further, the present material has made it possible to study closely the clinical course of the lesion and the pathologic-anatomical changes produced by the abortus bacilli in the genitals of the bull.

The animals attacked by orchitis due to brucella infection become ill suddenly, with considerable elevation of the temperature and distinct impairment of the general condition; at the same time there develops rapidly a hot and tender inflammatory swelling in the affected half of the scrotum. This acute febrile stage of the disease does not last long. Within 8 to 14 days the general condition improves markedly, the fever subsides, and the appetite returns. The swelling of the affected half of the scrotum persists, however, but assumes gradually a more chronic character, as the edematous infiltration of the skin and the underlying structures disappears, and the local heat and soreness subside.

In some cases the swelling is firm and hard as caoutchouc, in others it is more or less tense and fluctuating, depending upon the character of the pathologic-anatomical changes present. In every case the ejaculate differs more or less from the normal in appearance. In the beginning of the disease the changes may be rather inconspicuous, so that the semen chiefly contains motile and apparently normal spermatozoa and only a small number of immature and abnormal forms, but often numerous pus

This discussion complements the article by Lagerlof in the December issue, in which sterility in the bull other than that caused by Brucella organisms was discussed.

*Jepsen, A., and J. Jorgensen, 1938. Brucella Infection in the Genitals of the Bull. *Medlemsblad for Den danske Dyrlaegeforening* 21:3-4. English summary by the authors.

cells, sometimes in the form of macroscopic flocules. In the later stages the semen looks thin and watery, and it contains only a few spermatozoa or none at all.

In 10 of the 12 bulls the pathological changes were localized in the testis and epididymis; in the remaining two animals the process was limited essentially to the epididymis. In addition, eight of these bulls showed also involvement of the seminal vesicle, which in some of the cases could be demonstrated by rectal exploration: enlargement and firm consistency on palpation of the seminal vesicle involved.

In all the cases here observed the affection was unilateral to begin with, but in two cases the infection spread within a few months to the other testicle, and in several of the remaining bulls the infection of one testis produced such degenerative changes in the other testis that the spermatogenesis ceased, and the animals became sterile. No particular pathologic-anatomical changes could be made out macroscopically in these testicles, nor could abortus bacilli be demonstrated in them. Histological examination showed edema of the interstitial connective tissue, but no or only slight cell infiltration. The epithelium of the seminiferous tubules was detached in part, so that spermatocytes and fully developed spermatozoa were absent or very scanty; in some tubules only the cells of Sertoli were preserved.

The pathologic-anatomical changes in orchitis due to abortus bacilli may appear in two forms. In one the testis shows one large or several smaller areas of dry necrosis with only slight tendency to softening, but with marked tendency to encapsulation with production of large amounts of fibrous tissue. In this form the swelling of the enlarged testicle remains unchanged for months; but gradually the contractions of the fibrous tissue makes the swelling subside—even to such a degree that a testicle with encapsulated necrosis may fall below the normal size of the testis. The other form is characterized by a marked tendency to purulent liquefaction, so that the completely necrotic testicle lies like a sequestrum in a pus-filled cavity formed by the fibrous thickened tunica vaginalis, being suspended above merely by the remnants of the spermatic cord. In these cases the swelling in the scrotum has a more or less distinct fluctuating character and it may sometimes go on to perforation with evacuation of the purulent content and fistula formation; in other cases the changes persist in the same state for months.

In the two bulls with epididymitis only the change consisted in multiple nodular necrosis accompanied by chronic indurative inflammation; in one case the affected epididymis contained also a little abscess.

The bacteriological examination showed that the chronically affected testicles and seminal vesicles contained only a relatively small number of abortus bacilli at the time when the animal was killed (in most of these cases from 4 to 8 months after the appearance of the disease). In several cases the presence of bacteria could not be demonstrated, neither by cultures nor by inoculation of guinea-pigs. This applies in particular to the necrotic testes, and this fact is the more striking because sections of the necrotic testicle shows seminal tubules in which the epithelial cells are crowded with immense masses of bacteria-like bodies which greatly resemble the intracellular abortus bacilli in smears from the placenta.

Excretion of abortus bacilli with the semen was demonstrated in seven of the 12 infected bulls. Of these seven bulls six showed infection of the seminal vesicles. Still, the abortus bacilli were present here only in small amounts; only in the case of one bull did we succeed in obtaining growth of a few colonies by inoculating many plates from three specimens of semen, while in the other cases the presence of abortus bacilli could be demonstrated only by inoculation of guinea-pigs. Attempts to infect brucellosis-free heifers by having them covered by the infected bulls gave negative results, but they showed at the same time that several of these bulls were capable of fertilization, their unilateral orchitis notwithstanding.

This experiment was carried out with a total of 14 heifers, 10 of which became

pregnant and calved at term without having been infected. Specimens of blood from these heifers gave a negative reaction for brucellosis throughout the experimental period (one or two months after the calving), and the afterbirths from all these heifers were examined bacteriologically as well as by inoculation into guinea-pigs—all with negative result.

In four cases fertilization was obtained merely by employing infected bulls for the covering, while the remaining six heifers were covered also by a sound bull or were given "artificial fertilization."

As no doubt the inflammation set up in the seminal vesicles by abortus bacilli is a very essential factor in the question concerning the rôle played by the bull in transmission of infectious abortion, in order to elucidate the frequency of this localization we have examined specimens of blood and genitals of 400 adult bulls killed in the public slaughter-house of Copenhagen. Nothing is known as to the history of the bulls here examined.

In every instance, bacteriological examination was made of the testicles, epididymes and seminal vesicles by inoculation of serum agar plates and incubation in carbon dioxide atmosphere. Whenever the organs presented any pathological changes, cultures were incubated also under aerobic conditions, and guinea-pigs were inoculated with material from these organs.

In the specimens of blood from these 400 bulls, 39 (or 9.75%) gave a positive agglutination, but usually in a slight degree (serum dilution 1 : 20). In six (about 15%) of these reactors abortus bacilli were demonstrated in abnormal seminal vesicles. The bacteriological examination showed that the secretion of the seminal vesicles in the acute stages of the inflammation contains large amounts of abortus bacilli, while the bacterial content of the secretion in the more chronic cases is only slight. In addition, five bulls with negative bacterial findings (although three of them gave a positive serum reaction) showed in the seminal vesicles some chronic indurative changes which in all probability represent the remnants after a passed Brucella infection. In these 11 cases the external genitals were normal except in one bull which had also an abscess of the epididymis.

These findings show that brucellosis in the bull rather frequently localizes in the seminal vesicles without involving the external genitals. The acute bacteria-rich stage of this vesiculitis appears to be of relatively brief duration, the lesion turning soon into a chronic form, in which the secretion contains but few abortus bacilli or none at all. In the seven infected bulls that excreted abortus bacilli with the semen but produced no infection on copulation the pathological changes in the genitals were in every instance of chronic character. On bacteriological examination of the ejaculate the presence of abortus bacilli was ascertained in cultures only from one bull, while in the other cases their presence could be demonstrated only by inoculation of guinea-pigs. This circumstance suggests that the bacilli were few in number, and it explains the negative result of the experiment aimed to have these bulls transmit the Brucella infection by copulation, the number of abortus bacilli in the semen being too small to produce an infection.

The demonstration of the Brucella infection in the seminal vesicles in the bull as a relatively frequent lesion (2.75% of the non-selected 400 bulls examined presented changes in the seminal vesicles produced by abortus bacilli) correlated with the fact, that the secretion of the seminal vesicle produced in the acute stage of the lesion is very rich in abortus bacilli, makes it highly probable that infection from copulation may readily take place in the acute phase of the lesion.

So employment of bulls giving a positive serum reaction for Brucella infection implies a certain risk. Careful clinical examination of the external and internal genitals together with bacteriological examination of a specimen of semen may reduce this risk to some extent. Still, a negative serum reaction in dilution 1 : 20 in the bull may very well be associated with Brucella infection of the genitals.

Strongylidae of the Horse

By E. A. BENBROOK, Ames, Iowa
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THE Strongylidæ are the common, destructive roundworms (nematodes) of the large intestine of the horse. The larvæ of certain species may migrate into the mucosa of the large intestine, blood vessels, and various other organs. They belong to the same family as the nodule worms of cattle, sheep, goats, and swine, and the swine kidney worm.

Fifty-eight species of strongyles have been described. All have a buccal capsule. Larger species are usually attached to the mucosa; a smaller form (Trichonema, cylicostomes) is usually free in the lumen. In color the strongyles are white, red, or dusky gray.

The life cycle of the strongyle family is direct; that is, there are no intermediate hosts. The adults lay eggs which pass out with the feces and hatch in about 20 days if in a favorable environment of moisture, shade, and temperature. The larvæ are infective in five to six days; they may live for months, or even years. Ingested larvæ of larger species migrate through the body before returning to the large intestine. They may form abscesses in the walls of the cecum and colon. Larvæ of smaller species (Trichonema) invade the mucosa of the cecum and colon, then return to the lumen.

Probably all species suck blood, injure the intestinal mucosa (thus allowing the entrance of infection), cause abscesses, and produce toxemia through disintegration, or by the production of specific toxic substances. Wandering forms produce abscesses in various organs, and areas of calcification. The larvæ of *Strongylus vulgaris* produce thrombosis, aneurism, and chronic arteritis of the anterior mesenteric artery and branches. Embolism and infarction of the intestine may induce colic. Irritation of the nerve supply to the intestine may result in impaction, intussusception, or volvulus. Rupture of aneurisms may cause fatal hemorrhage.

■ Symptoms of strongyle infestation include emaciation, anemia, weakness, diarrhea, various forms of colic, and rough hair coat. Worms may be passed with the feces, and the eggs may be detected by microscopic examination of the feces. A simple technique of making the fecal examination is shown in Figs. 1-8. The appearance of the eggs of two typical species of Strongylidæ is shown in Figs. 11-14. The numerous species of this family have not been differentiated by the appearance of the eggs, which are quite similar.

■ Control of these parasites is based on both prevention and treatment. As preventive measures, stables should be kept clean and fecal contamination of feed and water avoided. Low, wet pastures should not be used; rotation of pastures is desirable. Overstocking should be avoided. As a routine precaution, the feces of all new animals should be examined, and treatment administered where necessary before they are allowed to mingle with the other horses.

■ Before treating, anemia, calcium deficiency, constipation, or fever, if present, should be corrected. The utmost care should be used in treating very old, very young, nervous, weak, or pregnant patients. Fast all patients for 36 hours before treating; then administer (1) oil of chenopodium (one dram for a 250 lb. colt; four to five drams for a 1000 lb. horse), preceded or followed by one quart of raw linseed oil; or (2) carbon tetrachloride (six to 12 drams per 1000 lbs.), especially for large strongyles; or (3) normal butylidene chloride (90cc per 1000 lbs.), followed in five hours by one quart of raw linseed oil.

In the northern United States, horses should be treated for strongyles twice a year, in the late spring and the early winter. In no case should the treatment be repeated oftener than at four to six week intervals. Treatment for bots and Strongylidæ should not be administered simultaneously.

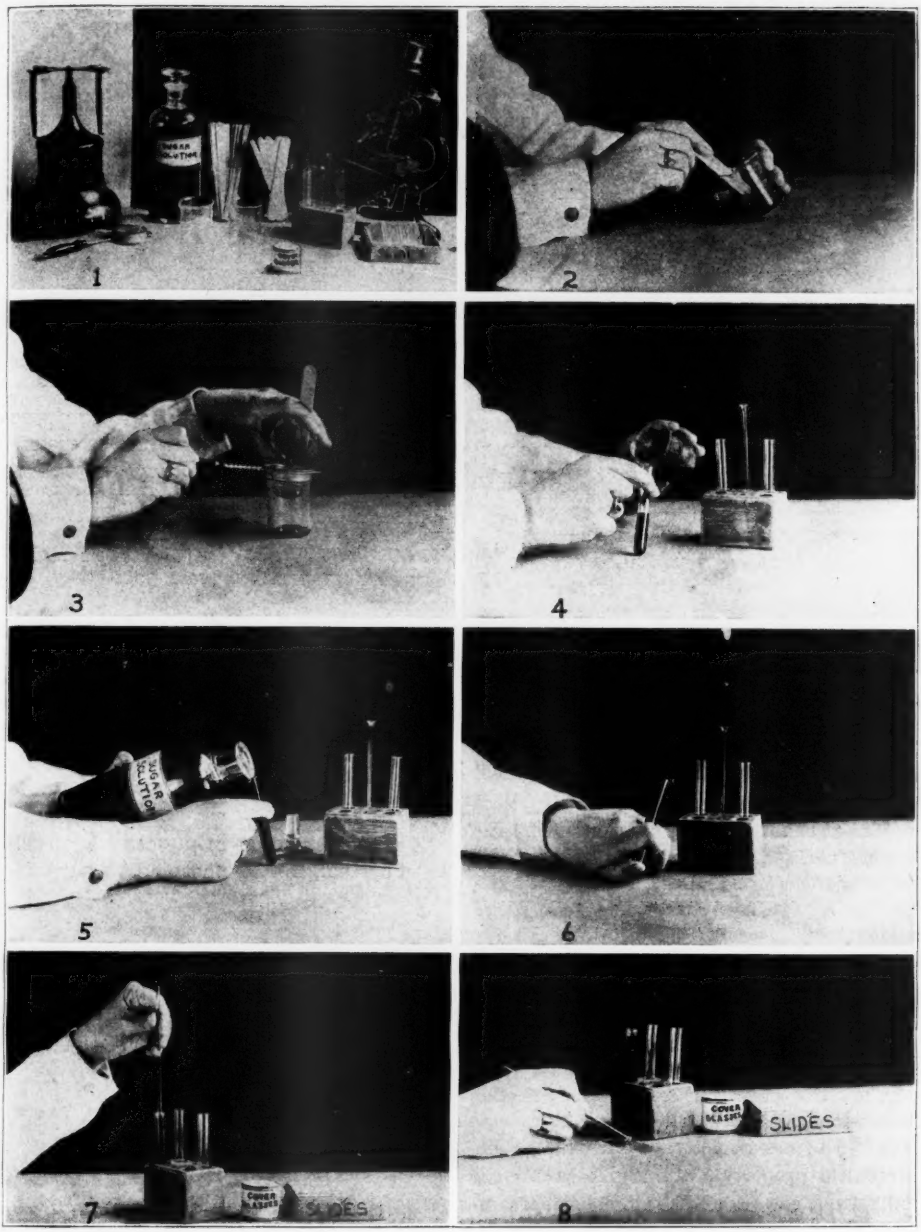


Fig. 1. Equipment for making fecal examinations.
Fig. 2. Mixing feces with enough water to liquefy.
Fig. 3. Straining to remove coarse particles.
Fig. 4. Filling a tube nearly half full of the fecal suspension.
Fig. 5. Adding a saturated sugar solution equal in amount to the fecal suspension.
Fig. 6. Mixing sugar solution and feces by inverting.
Fig. 7. Lifting off the surface layer of liquid from the tube after centrifuging, using a "headed" glass rod.
Fig. 8. Transferring a drop of the contents from the tube to a microscope slide.

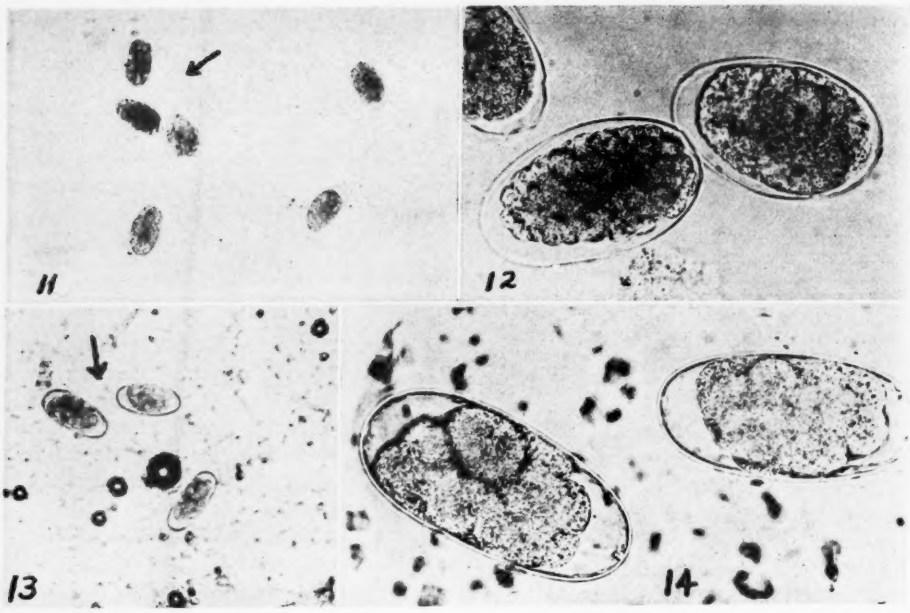


Fig. 11. Eggs of Strongylus vulgaris. X 100.

Fig. 12. Same as Fig. 11. X 400.

Fig. 13. Eggs of another species of Strongylidae. X 100.

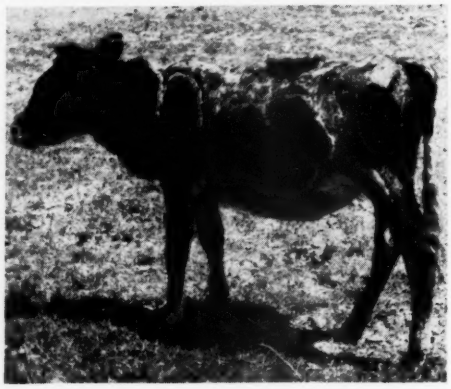
Fig. 14. Same as Fig. 13. X 400.

Porphyrinuria in a Yearling Hereford

Although sunshine has long been suspected of being important in conserving the health of man and animals, its real significance was not realized until the discovery of ultraviolet rays which constitute about 1 per cent of sunshine and an indefinite portion of skyshine. A considerable portion of the ultraviolet rays is filtered out by glass and by smoke, dust, moisture, etc., in the atmosphere. Therefore, the dwellers in smoky cities are deprived of one of the essentials of health. It has been demonstrated that the milk of cows exposed to ultraviolet rays has greater antirachitic property (vitamin D), than the milk from cows that have not been irradiated; likewise, eggs produced by irradiated hens have greater antirachitic properties than eggs from hens not so treated.

It is indisputable that phototherapy when indicated and properly applied is a valuable therapeutic measure. A practical means of standardizing exposure to ultraviolet light would permit of its more extensive use.

A large percentage of the cases of rickets is due directly to insufficient sunshine



Sunburned calf. Exposed white areas exhibited acute dermatitis. Colored areas were unaffected.—*Photo by M. W. Bradshaw.*

(ultraviolet rays), or indirectly to foods that have not had a proper exposure to such rays during development.

There is at least one condition in which ultraviolet rays produce a violent and unwanted reaction. It is a condition affecting man, characterized by the formation and deposit of porphyrin, an iron-free

Cow showing lesions of dermatitis due to photosensitization.—*Photo by E. J. Frick.*

pigment closely allied to hemoglobin. This phenomenon is manifested by a purplish color of the urine and teeth and a hypersensitiveness of the skin to sunshine. Persons so affected find it necessary to wear heavy veils and gloves to protect themselves from ordinary sunlight. (*Jnl. A. M. A., 86:12; Science,* No. 1629).

Veterinary literature appears to contain no report so far of porphyrinuria in domestic animals. A case in a yearling Hereford was observed by Lee T. Railsback of Harrison, Ark., and reported at a meeting of the Southwest Missouri Veterinary Association held at Carthage, November 15, 1938.

This animal was purchased and placed in a pasture with some 18 or 20 other yearling cattle. It was apparently normal at the time. Later, the owner noted that it was unthrifty and called Doctor Railback.

Unthriftiness, dry skin and muzzle, cutaneous hypersensitiveness, and purple discoloration of the teeth were the symptoms noted. None of the other cattle were so affected. Comments on this case from readers of VETERINARY MEDICINE will be appreciated.—*A. T. K.*

* * * *

Pulmonary Strongylosis and Ascaridiasis

What is the difference in the conditions produced in the lung by larval ascarids and lung worms and how can one differentiate them?

COMMENT: The symptoms of pulmonary strongylosis vary with the degree or extent of infestation. This condition is more common in shotes two or three months of age. There is unthriftiness and cough in the beginning. As the disease progresses, the cough becomes paroxysmal.

The principal lesions of porcine pulmonary strongylosis are found in the posterior and superior portions of the lungs. In the beginning the lesions consist of cone-shaped foci which are usually atelectatic though they may protrude and have a doughy consistency. In the later stages the foci are found to contain mucopurulent, purulent, or caseated material. Similar material with strongyles and ova are usually found in the bronchial tubes and trachea.

Thumps, cough, nasal discharge, unthriftiness and impaired appetite are the usual symptoms of pulmonary ascaridiasis. These symptoms develop in rapid succession in little pigs and the mortality rate may be high. The symptoms are less intensive in pigs six weeks of age and older. Generally speaking, the disease is less common and less fatal in shotes that have reached an age of three or four months.

The lesion of pulmonary ascaridiasis is primarily an embolic pneumonia with or without abscess formation. There is usually a marked serous infiltration or edema of the pulmonary tissue. Hemorrhages of varying dimensions may occur. Larval ascarids are usually present.

History, symptoms, lesions and age incidence usually suffice to differentiate pulmonary strongylosis from ascaridiasis.

Anaplasmosis-like Disease in Swine

Fourteen 50-lb. Duroc pigs, of which seven were obviously ailing, were vaccinated on December 1st with serum and virus. The ailing pigs showed temperatures up to 104° F. There was no coughing, thumping, vomiting, or scouring, but the sick pigs refused food and were weak and unsteady, especially in the hind parts. There was some gluing of the eyelids. One showed loss of hair as in mange; two were icteric; one had red, irregular spots under the epidermis on the ventral surface. No diagnosis was made.

Two days later a post-mortem examination of the carcass of one pig that had died revealed an icteric condition throughout. Yellow fluid flowed freely from any portion of the body upon incision, coagulating in a few minutes. The lymph glands, although showing no hemorrhages or congestion, were very yellow and watery. The lungs were normal, but the heart muscle had irregular, small hemorrhages on its surface, and both auricles and ventricles were full of yellow fluid. There were small petechiæ on the kidneys. The spleen was greatly enlarged and of a soft, dark color. The intestines were of normal color, with only a few ascarids present. The liver was normal in size, but had a pale yellow tinge. Bile was scanty, and the gall bladder was very small, containing a gummy substance. The joints of the legs showed no lesions. Diagnosis was withheld.

I am now seeking your opinion on this bunch of shotes. I have never seen a case of swine erysipelas in the flesh, but somehow I feel that there might be both cholera and erysipelas in these pigs.—*J. B. R.*, Mo.

Comment: Although some of the symptoms listed are suggestive of cholera, other symptoms, notably the temperature and the icterus, and the autopsy findings, are unlike cholera.

The temperature on the first visit does not indicate paratyphoid or suipestifer infection.

The greatly enlarged spleen in the shote autopsied, the icterus in at least two of the shotes, and the scurvy-like skin in another, indicate that the condition may have been due to a parasite in the red blood cells. For the want of a better name, this condition is called "anaplasmosis-like disease in swine."

Except in acute cases, swine affected with this malady usually show improvement following the administration of Fowler's solution in dram doses once daily in the feed. Where quicker results are desired, some arsenical preparation, such as sodium cacodylate, may be given, intravenously.—*A. T. K.*

* * * *

Milk a Cause of Digestive Disorders in Swine

Information relative to four hogs with the following history is desired. Four hogs were in the fattening pen where they had been fed for the past three weeks. The feed consisted of equal parts of ground rye and barley soaked for 12 hours and then mixed with fresh separator milk. The four hogs were apparently normal when fed in the evening of October 29th. One hog was found dead on the morning of October 30th.

On autopsy of the dead hog, the mucosæ of the stomach and small intestine were congested and there was an apparent rupture in the small intestine. The other three hogs were visibly sick. What was the cause of this malady, and how can further losses be prevented?—*W. G. S.*, Kans.

Comment: Many reports have been received in which fresh separator milk appeared to be a factor in the etiology of digestive disorders. There seems no doubt that the death of one hog and the apparent sickness of three others was of dietary origin. It appears a reasonable conclusion that disorders of this kind will not recur if the milk is permitted to sour before feeding.

Comments from readers of VETERINARY MEDICINE will be appreciated.—*A. T. K.*

Washing Powder Poisoning in Swine

Four hogs were kept in a small lot in which there were a few cockleburs and many poke weeds. All four hogs were apparently normal when fed kitchen slop in the evening. The next morning two of the hogs were in a semi-comatose condition and the other two were wobbly. The temperature of the semi-comatose hogs was normal. Both died two days later. The other two survived but were extremely weak.

Post Mortem.—An autopsy was held on the last animal to die. The owner had given it a dose of epsom salts. The lesions consisted of two congested areas in the gastric mucosa, a small area of solidification in one lung. The larynx was congested. All other organs were apparently normal. What was the cause and treatment, if any?—*C. P. & C. D. M.*, Mo.

Comment: The history and autopsy findings are suggestive if not indicative of some chemical poison or of poisonous plants. Young cockleburs are poisonous for hogs but this is off season for cocklebur poisoning. Further, cocklebur poisoning is manifested by gastroenteritis and there was no evidence of gastroenteritis.

Poke weeds are poisonous for swine, particularly the berries and the root, but you do not state that the hogs had eaten any poke weed plants to which they had access.

It is apparent that the hogs did not die of infection or poisoning from plants in the lot and by elimination it seems probable that the cause of the condition was in the slop. Just what the poison was remains to be determined. Salt water brine, and cleaning powders are frequently the cause of poisoning.—*A. T. K.*

* * * *

Two hundred and fifteen veterinarians in Illinois reported 6,033 cases of encephalomyelitis in 85 counties in 1938, with a loss of 1,535 animals (25.44%). The disease incidence among unvaccinated horses in infected districts was 3 1/3%; among vaccinated horses in the same district 0.25%.

Who should study veterinary science? Both men and women are making a success in this field. It is difficult to paint a picture of the ideal veterinary student. Success is possible in too many diverse fields. First of all the prospective student should be a student—a good student—for the curriculum is not easy. He should like animals and should know or be willing to learn all there is to learn about them. He should be interested in medicine, for he must learn to apply medical science and art to the solution of animal disease problems. He should possess those personal qualities that make for success in any profession.—*Ward Giltner.*

* * * *

Carbon Monoxide Poisoning in a Dog

The interesting case of acute carbon monoxide poisoning in a dog reported by Dr. Joseph R. Sterling (VETERINARY MEDICINE, February, 1938, p. 66) somewhat parallels the case of my wire-haired fox terrier recently. The source of the poisoning was the exhaust fumes of an automobile in the garage where I had placed him. I had been working on the engine while it was running for some little time, when I noticed the dog walking in a staggering manner. I thought it odd at the time, but did not do anything about it until I noted the vomitus, urine, and feces on the floor near the exhaust pipe, where he had been lying. I then realized what was happening and took him out into the fresh air.

Evidently my dog was not as greatly affected as the case described by Doctor Sterling, for he was in fairly good health the next day, and has been ever since. I myself did not notice any effects of the exhaust fumes. This was perhaps because I was much farther away from them than was the dog. Or perhaps animals are more susceptible to such poisoning than man. I wonder how often pets are made ill from exhaust fumes in small garages, especially when, in winter, the ventilating spaces are boarded up to keep out the wind and cold, as is frequently done.

R. DE R. BARONDES, M. D.

San Francisco, Calif.

High Serum Magnesium Associated with Urinary Calculi in Sheep

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NEWSOM[1] in his discussion of the causes of urinary calculi in cattle and sheep considers hard water, vitamin A deficiency, mineral imbalance, urinary reaction (*p*H), hyperthyroidism, infections and urinary irritation as possible etiological agents. Watchorn[2] has reported a high incidence of renal calculi in rats fed a diet high in magnesium carbonate. She found that the formation of calculi accompanying high magnesium diets was prevented by the addition of an excess of calcium carbonate. Pontius, Carr and Doyle[3] have found that the urine from sheep with calculi is very alkaline. They consider the irritation of the urinary tract by a highly alkaline urine as a predisposing cause of calculi formation.

The following case report suggests the possible rôle of mineral imbalance in the production of urinary calculi in sheep and tends to eliminate certain factors as contributing influences.

The owner of 900 feeder lambs reported on January 3, 1938, that during the previous ten days, six lambs had died with ruptured bladders. The condition had been very acute because symptoms had appeared only during the previous two-week period. These were Wyoming lambs that had been purchased in Omaha, September 23, 1937. From September 23rd until November 1st they had grazed in blue grass pasture that contained a stream of running water. November 1st they were turned into a cornfield and a fresh blue grass pasture. November 5th they were given corn sugar molasses (self fed) and one-fourth pound of a proprietary 37% protein concentrate. They ate about one-fourth pound of the molasses daily. On December 10th the lambs were put on dry lot and fed 1½ pounds of shelled corn, ¼ pound protein supplement, corn sugar molasses and one pound soybean hay. They had access to fresh water which was reported to be very low in mineral content. Death losses had been about 1%.

January 20, 1938, two lambs showing symptoms of ruptured bladders were bled for chemical examination of the blood. One of these lambs was also examined, post mortem and found to have a very much enlarged gall bladder containing a large gall stone. At this time about 2% of the lambs had died of urinary calculi complications, a matter of 19 cases in 35 days. The owner reported that many of the lambs were lame, especially in the hind legs. They had been vaccinated for hemorrhagic septicemia. In general, the condition of the lambs was good.

The calcium and magnesium content of the serum of the two lambs in milligrams per cent were as follows:

	Ca	Mg
A	10.8	6.5
B	9.4	5.6

For comparative purposes the range and average values for calcium and magnesium in the serum of 35 lambs killed at the abattoir are given in milligrams per cent.

Ca	Average	Mg	Average
7.9 to 11.2	9.2	2.4 to 3.5	2.9

Similar figures for 15 well-fed farm sheep may be cited in this connection:

Ca	Average	Mg	Average
9.7 to 13.5	10.98	2.8 to 3.6	3.25

It can be seen that the magnesium values obtained in the two diseased cases are much higher than the highest value recorded for "normal" lambs.

In a consideration of the probable etiological factor there are certain possibilities that can be ruled out; the water was low in mineral content; the blue grass pasture would certainly furnish vitamin A enough for considerable storage, even though the lambs were partially deficient when purchased; hyperparathyroidism is apparently eliminated from the point of view of numbers involved and of the normal serum

calcium; infection seems unlikely because of the low death losses up to the time of casualties from ruptured bladders. Thus we have left as possible contributing factors mineral imbalance, urinary reaction and urinary irritation. Mineral imbalance seems the most plausible factor of the three in considering the ration.

The ingredients of the protein supplement are not known, so it cannot be evaluated in a discussion of the composition of the ration; however, most of the protein-rich feeds are relatively high in magnesium. Soybean hay is high in magnesium and calcium, while in shelled corn the ratio of Mg to Ca is approximately 10:1. Corn sugar molasses is quite high in sodium chloride. The ration fed to these lambs after they had been placed on dry lot was decidedly high in magnesium, relatively low in calcium and quite satisfactory in phosphorus content.

A portion of the ingested magnesium and calcium is unabsorbed and excreted in the feces. Some is absorbed and excreted back into the intestine through the intestinal wall and by way of the bile. Both calcium and magnesium, however, are excreted in the urine. In certain species excreting both an alkaline bile and urine (especially herbivora), it is very probable that during the concentration of these fluids in the gall bladder and the renal tubules the high concentration of magnesium salts of phosphoric acid may exceed the solubility of compounds of magnesium and calcium with phosphates; resulting precipitation could form urinary and biliary calculi.

Unpublished observations made on swine have shown that high magnesium-low-calcium rations produce lameness in the hind legs. These animals also show normal serum calcium and high serum magnesium. Swine appear to be very resistant to the formation of urinary calculi.

It has long puzzled practitioners to account for loss from calculi lodged in the urethra, particularly of wethers and feeder steers. It has been attributed to "alkali water" and to insufficient water, to sugar beet pulp and to other causes that have always seemed to act intermittently. This observation, while it by no means settles the question, negatives most of the older theories and adds considerable support to the theory of mineral imbalance.

The results obtained by Watchorn[2] with rats would suggest a beneficial effect from adding calcium to a high magnesium ration. In actual practice the incidence of urinary calculi in sheep is frequently lowered by including alfalfa hay in the ration. Alfalfa is usually quite high in both calcium and magnesium.

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2. Watchorn, E., 1932. The effects of excessive intake of magnesium by the rat, especially concerning the factors relative to the production of renal calculi. *Jour. Hyg.* 32, p. 156.

3. Pontius, B. E., R. H. Carr and L. P. Doyle, 1930. Urinary calculi in sheep. Proc. Soc. Animal Prod., p. 185.

Band of 1,800 sheep on Idaho wheat stubble.—*Photo by E. T. Baker*

Canned Dog Food as a Source of Energy for Dogs

By CARL J. KOEHN, Auburn, Alabama,
Laboratory of Animal Nutrition, Alabama Polytechnic Institute

WITHIN the past few years, the use of commercial canned dog foods has increased to a great extent and has come to be recognized as a definite economic problem to dog owners. In spite of the widespread use of these products, very little scientific information has been published on their energy value and little is known concerning the amount necessary to nourish a dog. Some work has been reported on the energy requirements for maintenance of dogs under various conditions, by DeChambre[1], Linton[2], and Brody, Proctor, and Ashworth[3], but most of these experiments have been with adult dogs on experimental rations. It is an entirely different problem, however, to maintain dogs, and particularly to raise pups, on canned dog foods.

■ The feeding directions on the labels of most canned dog foods are erroneous or misleading, and the purchaser is generally led to over-estimate the energy value of the food. Since brands of canned dog food differ in calorific value and availability of this energy, the quantity of food required by the dog varies with the brand fed. In order to determine the extent of this variation, a number of commercial canned dog foods were analyzed chemically. Several of these foods were fed to dogs as the sole article of diet to determine the energy requirement for growth and maintenance.

Experimental Procedure

Twenty-three brands of commercial canned dog food were purchased on the open market. These foods were sampled and moisture determinations were made by the method previously described by the author[4]. Complete proximate chemical analyses were made by the official methods of the A. O. A. C.[5], and the calorific values and nutritive ratios were calculated. These values are given in Table I. Included are the values for the Auburn ration described by Salmon[6] which was used as the stock and control diet. The results of the actual chemical analyses have been reported previously[4] and correspond to the same brand numbers. Seven of these foods were chosen for feeding trials with dogs; these were purchased in large quantities and the same lots which were sampled for analyses were fed to the dogs.

The dogs used for feeding tests were pure bred, American foxhounds from the laboratory stock kennel which received the Auburn ration as stock diet. Each litter used for experiment was reduced to eight pups and received the bitch's milk for the first four weeks after birth; the bitch's milk plus cow's milk for two weeks; cow's milk plus the Auburn ration the next week; and the Auburn ration alone during the eighth week. The pups were started on the canned foods at the age of eight weeks in groups of four, litter and sex distribution being practiced as much as possible. The dogs were kept relatively free from worms and were dipped once a week in lime-sulphur dip. Daily feed and weekly weight records were kept.

Each group of four pups was housed in a separate kennel, 6x6 feet, with a 6x12-foot outdoor runway. The dogs were allowed to exercise once a week for several hours in an exercise yard 40 x 100 feet.

They were fed daily at 9:00 a. m. and 4:00 p. m. only as much food as they would eat readily at one feeding. No food was available to them except during the 30-minute feeding periods. This feeding practice kept the dogs in firm flesh and did not lead to obesity. The Auburn ration, which was fed to the control group, was

mixed with water and baked in the form of bread. Tap water was available to the dogs at all times.

Results and Discussion

In Table I is shown the wide variation in calorific value and nutritive ratio of canned dog foods. The calorific value of the foods was affected most by the water content, although the amount of fat and minerals also played an important part. Several dog foods contained such excessive amounts of minerals as to appreciably lower their energy value. Brand 5, for example, contained about 20% ash (calculated on the dry basis), most of which is superfluous and is not utilized by the dog.

TABLE I. CALORIFIC VALUES AND NUTRITIVE RATIOS OF COMMERCIAL CANNED DOG FOODS

Brand Number	Calories per Gram	Nutritive Ratio	Brand Number	Calories per Gram	Nutritive Ratio	Brand Number	Calories per Gram	Nutritive Ratio
1	3.31	4.9	9	1.06	2.8	17	0.95	2.8
2	1.32	1.4	10	1.32	2.2	18	0.92	1.5
3	1.32	2.9	11	1.22	1.5	19	0.84	1.3
4	1.14	1.9	12	1.23	2.7	20	0.79	2.8
5	1.04	1.9	13	1.20	1.7	21	0.85	2.1
6	1.29	1.8	14	1.11	1.6	22	0.89	2.0
7	1.17	1.8	15	1.09	2.6	23	0.77	3.1
8	1.27	2.5	16	0.99	1.3	Auburn	3.30	2.5

■ The nutritive ratio of commercial canned dog foods varies mainly with the ratio of fat to protein since the carbohydrate content is relatively uniform. Although some fat is essential in the diet and is valuable in raising the calorific value of the food, the use of too much fat in canned dog food is objectionable. Brand I, for example, contained about 47% (calculated on the dry basis) of high melting fat, which caused digestive disturbances when fed to dogs on experiment. The increase of fat in canned dog foods even in amounts not great enough to cause digestive disturbances causes a decrease in food consumption which may lead to a deficiency in minerals, vitamins and protein unless these are raised to a correspondingly high level.

■ In Table II are shown data on the food consumption and energy requirements of dogs fed five brands of commercial canned dog food. The values for the maintenance requirement of adult dogs agree with those found by Cowgill[7] for dogs on experimental rations. Brands 9, 14, and 15 may be considered complete diets since they produced normal healthy dogs and allowed normal reproduction. Brand 12 was deficient in vitamin D and Brand 13 was deficient in calcium. Brands 1 and 22 were also fed, but they were of such poor nutritional quality that the data obtained were useless in energy studies and will be discussed elsewhere. It is interesting to note that under the conditions of this experiment the dogs utilized the energy from the Auburn ration more efficiently than from any of the canned dog foods fed, even though the

Once upon a time a dog was supposed to rustle or forage for his food. But that's largely past. The increasing tendency of the American family to sup on prepared food in cellophane or cans from the corner delicatessen has impoverished its table scraps and depleted its garbage can at the same time that increasing restriction on the dog has limited his liberty to seek far afield to satisfy his appetite. These changes made prepared dog food inevitable, but not even the most optimistic visioned its pyramiding from scratch to a 130 million dollar industry in 10 years. But that is what happened. What the industry is giving the dogs in exchange for the 130 million dollars is another story, a part of which is told in this article.

TABLE II. GROWTH, ENERGY REQUIREMENT AND FOOD CONSUMPTION OF DOGS RECEIVING COMMERCIAL CANNED DOG FOOD AS THE SOLE ARTICLE OF DIET[1]

Brand Number	Body Weight, Kgms. 8 wks.	34 wks.	Energy Required Cal. per Kg. Body Weight 9 wks.[a]	34 wks.	Daily Food Consumed Pounds[b]	Total Food Consumed Pounds[c]
9	6.13	21.05	280	103	4.8	877
12	5.70	15.55	223	112	3.3	599
13	3.83	16.09	296	86	3.1	568
14	4.40	19.07	257	87	3.3	585
15	3.88	19.72	287	91	4.5	818
Auburn	4.79	21.22	224	70	1.1	200

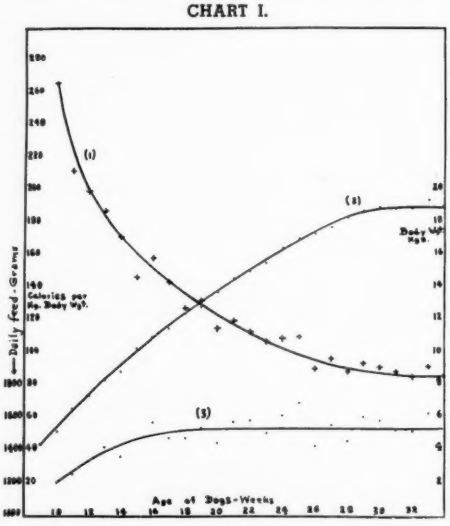
1. Each value represents the average of 4 dogs.
a. The energy consumed during the first week of experiment is omitted because the food consumption was limited to allow the dogs to become adjusted to the change in diet.
b. Average value per pup for the 26-week experimental period.
c. Total food consumed per pup for the 26-week period.

Auburn ration has a high percentage of cereals.

The curves in Chart I show the relationship between energy requirement and rate of growth of dogs receiving a good grade of commercial canned dog food (Brand 14). These curves represent the average values for four dogs and are typical of the results obtained with other dog foods. Curve 2 shows that the rate of growth of the dogs was greatest at the start of the experiment and that this rate continuously decreased until the dogs reached maturity, whereupon the curve rapidly flattened out. Curve 3 shows that the food intake increased rapidly for a few weeks, then leveled off and remained more or less constant even though the dogs were still growing. These dogs consumed as much food at 18 weeks of age as they did at maturity even though they weighed only half as much. The close relationship between energy requirement and rate of growth is shown in Curve 1. The energy requirement was highest at the start of the experiment; it dropped rapidly at first and then gradually decreased to the maintenance level.

■ It is interesting to compare these results with the feeding recommendations on the labels of commercial canned dog foods. Although there is a great variation in the calorific value of these foods as shown in Table I, the feeding directions on the labels of all the canned dog foods studied are practically the same with the exception of those which state that the amount to be fed should be regulated by the size, condition, and activity of the dog. Brands 2 and 20, for instance, give the same feeding directions even though the former has a 30% higher calorific value. Mature dogs (40-50 pounds) receiving Brand 14 required 1,653 calories or 3.3 cans of food per day. The manufacturer recommended 1.5 cans per day for a dog of this weight, which is less than half the required amount. Dogs receiving Brand 15 required 1,794 calories or 3.8 cans per day for maintenance at maturity, while the label called for one can per day. Moreover, these same dogs at 18 weeks

CHART I.



A Meeting of Hounds at Lucknow, India.

Special care must be given to bitches during gestation and lactation. A healthy dog should be fed, under any condition, as much food as necessary to keep it in firm flesh but not obese. Some manufacturers of canned dog food have adopted such directions for the labels and are to be commended for this practice.

of age weighing 20-30 pounds required the same amount of food as they did at maturity. Directions on the label called for one-third of a can per day for a dog of this weight, which is less than one-tenth the amount actually required!

It is evident from these data that if a dog is fed according to the directions on the labels of most brands of canned dog food, it must procure the bulk of its energy from some other source. Feeding directions based on body weight, even though correct for mature dogs, would be useless for the feeding of growing pups or for bitches during gestation or lactation. It is shown by the results given in this paper that a dog 18 weeks old may require as much as three times the amount of food per unit of body weight as it will at maturity. In other experiments in this laboratory mature bitches normally eating four cans of dog food a day ate as many as eight cans per day during lactation.

■ The physical activity of the dogs during the course of these experiments may be described as mild exercise. DeChambre[1] has shown that the energy requirement of dogs increases considerably during moderate or hard work. It is evident, therefore, that in giving feeding directions for a canned dog food, consideration must be given to the energy value of the food, and to the age, size, and physical activity of the dog.

Summary

The calorific value of the 23 brands of commercial canned dog foods studied varied from 0.77 to 3.31 calories per gram of food. The nutritive ratio varied from 1.3 to 4.9. Whenever specific feeding directions were given on the labels of the dog foods studied, these were found to be erroneous and misleading. Adult dogs weighing from 40 to 50 pounds required canned dog food equivalent to 86 to 112 calories per kilogram of body weight daily. From three to four cans daily of most dog foods were needed to meet this requirement. Young growing pups were found to require about three times the amount of food, per unit body weight, as the same individuals at maturity. The food requirements of bitches is doubled during lactation. Healthy dogs should be fed, under any conditions, sufficient food to keep them in firm flesh but not obese.

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X-Ray Diagnosis in Small Animals

By DR. GERRY B. SCHNELLE, Boston, Massachusetts,
Angell Memorial Animal Hospital

WHILE roentgen therapy is still of questionable value to the average veterinary practitioner, the diagnostic value of the roentgen ray is of major importance to every veterinarian whose practice includes the dog and cat. Interpretation of the finished radiograph may be aided by reference to publications on human radiology by the physician radiologist, but it is very important that a foundation of a standardized technic and standardized position of the patient be established so that there may be correct anatomical comparison between the canine or feline and the human anatomical differences. Once correct routine positions for radiographic examinations are established, then correct interpretation of pathological lesions should result.

Anesthesia is desirable in radiography of any part of nervous dogs, of the abdomen and chest of large dogs, and in other instances when accurate detail in the radiograph is necessary for interpretation. For routine x-ray examination of dogs or cats, pentothal sodium (Abbott) is the anesthetic of choice. One-sixth to one-tenth grain per pound of body weight is given intravenously immediately before the radiograph is to be made. When operation is expected to follow the x-ray examination, then nembutal (Abbott) is used for anesthesia. It is given intravenously in the dosage of one-fourth to one-sixth grain per pound of body weight for cats and dogs. Anesthesia is rarely necessary in cats because the exposure time can be shortened to a minimum and motion thereby reduced to a point where its effects are negligible.

The development of fast intensifying screens and casettes has made the radiograph a far safer and more valuable diagnostic aid than the fluoroscope. Although for the chest and abdominal work the fluoroscope is often essential to correct diagnosis, the veterinarian usually lacks the expensive apparatus necessary entirely to screen himself from the rays while using the apparatus. Then, too, the animal must usually be held by either the veterinarian or his assistant for fluoroscopy and it may be impossible to avoid exposure of part of the operator's body to the rays. These factors tend to force the veterinarian to depend upon the radiograph and to learn to make and interpret it correctly.

The Author

The Head

The head is radiographed for neoplasms, foreign bodies, bone injuries or infection. Routine positions are flat and lateral. In the flat position great care must be taken to have the patient's head placed squarely on the maxilla so that the nasal septum will show as a white line bisecting the head. The nares, a frequent location of neoplasm or foreign bodies, are then clearly illustrated on either side of the septum so that any difference in density may be seen. Deflection or erosion of the septum will indicate neoplasm in the nares even though the growth is not of sufficient density to produce a shadow. The lateral view shows a profile of the skull and will localize fractures and indicate the amount of depression of the fragments. This view is also helpful in localizing needles which have penetrated the soft tissues of the pharynx or base of the tongue.

Encephalograms have not proved valuable in dogs when made in accord with accepted radiographic technic. When taken from anterior to posterior with the dog's

nose pointed at the tube and the film posterior to the occiput, the frontal sinuses are projected into the cranium and obliterate any view of the ventricles. Lateral films are unsuccessful because of the density of the skull and the slope of the bony cranium which increases the thickness of the hard tissues which the rays must penetrate.

The Neck

Radiographs of the neck, excepting those taken specifically to show the cervical vertebræ, are taken for "soft tissue" detail and consequently the kilovoltage is reduced to a point where the head and vertebræ are indistinct. Lateral views only are routinely taken. The larynx in adult dogs always shows some evidence of calcification and in an occasional dog which comes from a lime belt of the country the larynx may be entirely calcified without materially affecting the dog. It is also the site of a cartilaginous neoplasm which may be diagnosed with a good radiograph. Irregular erosion of the cartilage with apparent extension of the process into the surrounding tissue is the diagnostic feature.

Foreign bodies, particularly needles, frequently penetrate the pharynx and may travel into the muscles or areolar tissue of the neck and cause pain or abscessation, or both. A diagnosis can be made with a lateral film and several additional views may be made to localize the object preparatory to operation.

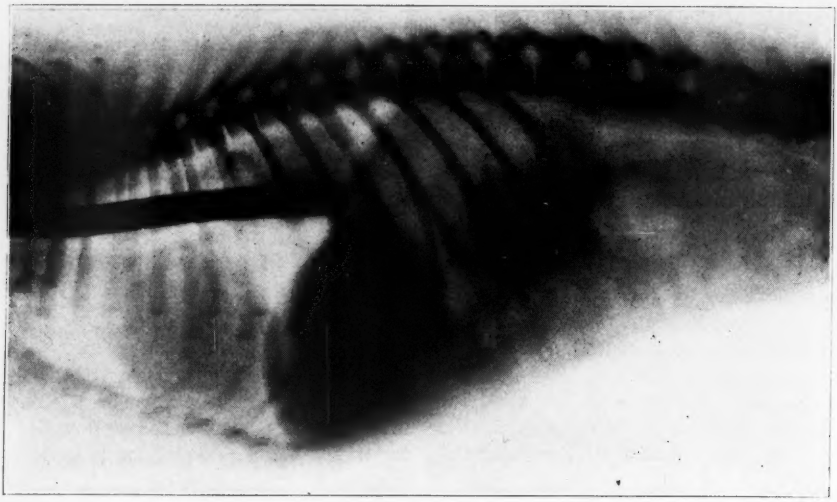
An argument for the use of the x-ray in veterinary practice is an argument for precision in diagnosis upon which, of course, rational therapy must be based.

The Shoulder

The scapulo-humeral joint is best shown by placing the limb wanted on the casette. The lower leg is extended and pulled anteriorly and the opposite leg is pulled posteriorly as far as possible. This brings the joint free of the chest and sternum so that the ribs and neck will not obscure the clarity of the joint detail. In the very large breeds an antero-posterior view of the joint may be obtained with the dog standing by placing the film in front of the dog, against the shoulder and chest, and placing the tube posterior to the joint flat against the ribs. The tube is aimed through the joint at the casette. The shoulder region is radiographed for dislocation, for fractures of the

X-Ray of Head of Dog with Mandible Removed

Before radiographing the head, No. 7½ shot were poured into the frontal sinus through an opening in the frontal bone made with a trephine and into the maxillary sinus through its nasal opening.—*Photo by H. G. Wixom.*



X-ray photograph—with a stomach tube passed down to the region just in front of the cardia of the stomach. —*Photo by A. H. Kleinfeld.*

scapular neck, for epiphyseal fractures of the humerus or for neoplasms of the proximal shaft of the bone, which are chiefly osteogenic sarcomas.

The Vertebrae

The vertebral column should always be radiographed in at least two planes for fracture, dislocation or disease. Since the vertebræ are complex interlocking bones, it is important to center the tube directly over the area from which radiographic detail is expected, to avoid projection of the body or processes of one vertebra upon the shadow of its neighbor. Dislocation occurs commonly in the region of the last thoracic vertebræ and is usually dorsoventral. More rare are dislocations in the region of the lumbar vertebræ, which are usually lateral. Fracture of the vertebræ is either a fracture-dislocation or a crushed (compression) fracture; in the latter case the vertebra is compressed and appears lined and dense.

Arthritis of the vertebræ may show first as spines projecting from the articular surface of the vertebral bodies, usually extending ventrally. This process may continue until a bridge forms, fusing the two adjoining bones. It may also evidence itself as calcification of the intervertebral discs, a detail impossible to demonstrate unless the tube is centered directly over the involved area.

The Pelvis

Uniformity of position in placement of the patient is essential to correct interpretation of pelvic radiographs. The dog or cat is placed on its back, the hind legs are pulled back as far as possible to simulate the position of a man standing. The toes should be rotated slightly inward instead of allowing them to rotate outward as they would naturally. This produces a flat view of the pelvis and allows examination of t acetabulum and the sacroiliac joints. This view also shows the weight-bearing surfaces of the femoral heads and the femoral necks to best advantage. In young dogs, especially wire-haired fox terriers, one may find flattening of the femoral head (coxa plana), or lessened angle between the femoral head and shaft (coxa vara). The latter may be due either to resorption of the femoral neck or to slipped epiphysis. While unilateral or shifting lameness with tenderness in the region of the hip is suggestive of this disease, a radiograph is necessary for correct diagnosis and prognosis. Dif-

ferentiation of fractured pelvis from femoral neck fracture is difficult without the radiograph. Tumors involving bone in the region of the pelvis are rare.

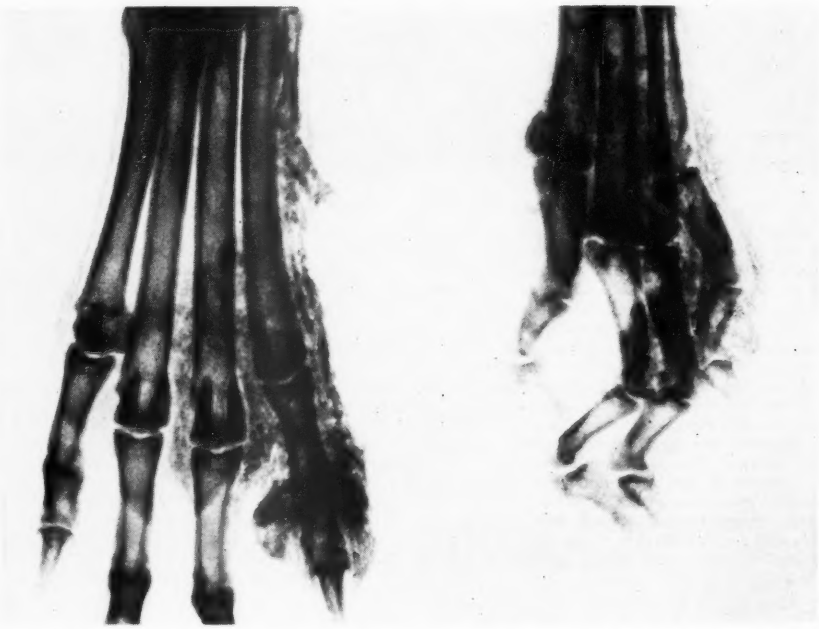
Uniformity of position and familiarity with the normal size, shape, and construction of the hip joint should make radiographic diagnosis of congenital subluxation or congenital dislocation easy. In both cases the acetabulum is shallow and the femoral head flattened and ill-fitting, the difference being only in degree of displacement.

The Long Bones

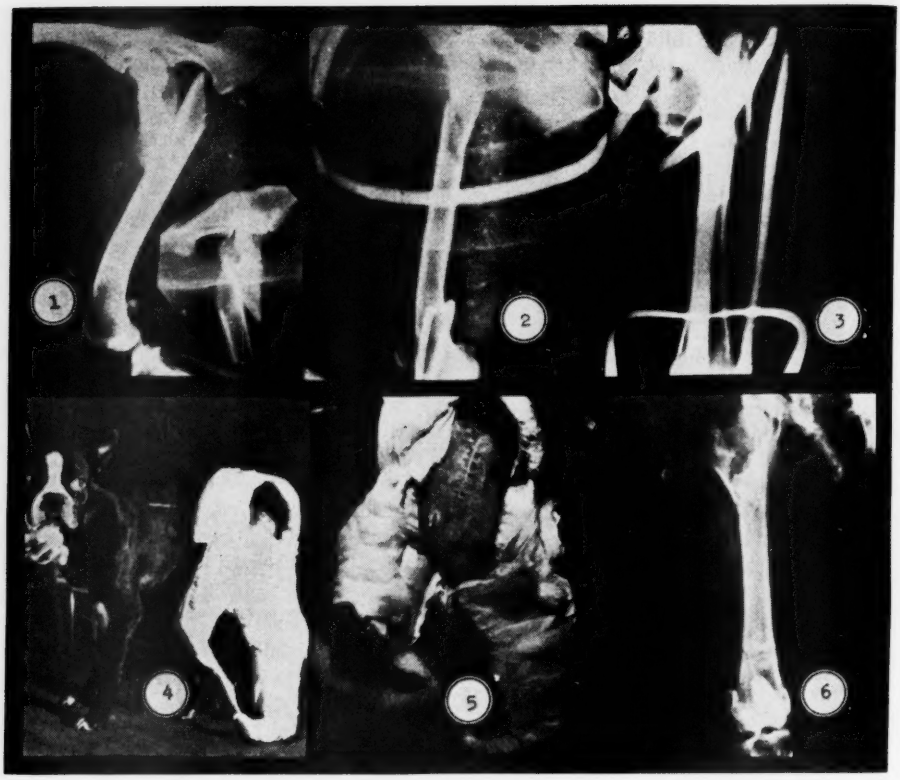
Radiography of long bones is done to diagnose and locate tumors or disease or, far more commonly, for fracture treatment. The veterinary radiologist should familiarize himself with the normal projected appearance of bone, the thickness of the cortex, the normal size of the shafts, the normal appearance of the epiphyses and the approximate time of their calcification. He should also be familiar with the various curiosities of canine and feline anatomy, as the penile bone of dogs, the cat's clavicle, the various sesamoid bones or the occasional extra rib which may cast a confusing radiographic shadow.

When the normal is recognized, then the hair-line thinness of the cortex and its lack of calcium make the diagnosis of osteogenesis imperfecta easy in young dogs. The widening of the metaphyses and its crushed appearance in rickets become a familiar sight in young dogs. The rachitic fractures which heal in a week or ten days can easily be explained if the veterinary radiologist is familiar with normal bone and can, therefore, identify these characteristic signs of rickets.

The diagnosis of various osteogenic neoplasms is of major importance to the veterinary practitioner. Although malignant



Two views of a forepaw of a Greyhound, 12 months of age. The history of the case is unique. The owner did not know of any injury to the foot, nor was anything abnormal noted until 14 days before the radiograph was taken, at which time the foot had been markedly swollen for only three days. Naturally, if the shadows along the bones indicate calcium deposits, one would suspect the condition to be several weeks, or months, or even longer in developing. The history definitely opposes this explanation. No embrocations or ointments of any kind had been applied.—*W. M. Nielsen, 67 Hall St., Cessnock, N. S. W., Australia.*



Radiographs of a Fractured Femur in a Boston Terrier

Fig. 1 shows the sharp pointed proximal extremity of the lower fragment adducted and pulled upward toward the tuber ischii. The fragments were separated by interposed muscle. Reposition was impossible by the usual closed method of manipulation and traction. Open reduction was therefore necessary in order to free the fragments from this barrier of interposed muscle before reposition of the fragments was possible. Fig. 2. Showing the fracture reduced (lateral view). The line of incision was made on the lateral aspect of the thigh extending from the trochanter major to approximately an inch above the lateral condyle, through the skin and superficial fascia. A careful incision (longitudinal) through the aponeurosis of the tensor fascia lata exposing the anterior border of the biceps femoris. This was reflected posteriorly separating it from the quadriceps. By proceeding carefully need for invading muscle tissue was avoided and therefore unnecessary mutilation and danger of hemorrhage. In this manner the bone is readily exposed and approached. Fig. 3. Showing an anterior posterior view of the reduction. Fig. 4. A photograph of the patient showing the splint in place. Fig 5. A (close up) photograph to show the healed incision and the tongs in position. This photograph was taken on the eleventh day after the operation. Splintage and tong traction *(moderate)* was continued until the thirtieth day and then removed. The tong wounds appeared aseptic. The patient was discharged three days later and showed an inclination to bear weight on the limb. The owner reported a week later stating that the dog was using the limb cautiously. The patient was returned for examination at the end of the seventh week at which time he was walking quite well. Fig. 6. Radiograph of the healed fracture at the end of the seventh week.

tumors—chiefly sarcoma or metastatic carcinoma—are frequently found, and consequently diagnosis rarely leads to corrective treatment, it is at least satisfying to be able to give a correct diagnosis and prognosis. The sarcoma presents a variety of roentgen appearances, but is always invasive, almost invariably occurs at the end of a long bone, and is usually single. The metastatic carcinoma occurs in any bone including small sesamoids, but rarely occurs in the young dog. Ewing's sarcoma occurs in the mid-

shaft of long bones and is diagnosed chiefly through its radio-sensitivity.

The knee joint requires special care in making antero-posterior views in suspected injuries to the joint ligaments. All knee joint radiographs should be made with the animal under narcosis or anesthesia so that complete relaxation is possible. Radiographs showing the abnormal limits of motion within the joint allow a diagnosis of rupture of the cruciate, lateral or medial ligaments.

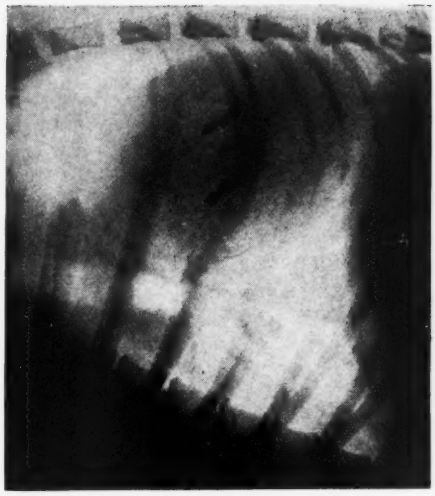
Lateral views of the knee, especially in the young St. Bernard or Newfoundland dog, may show a non-traumatic lifting of the tibial tubercle and fraying of the crest below it which is characteristic of Osgood-Schlatter's disease.

Fractures

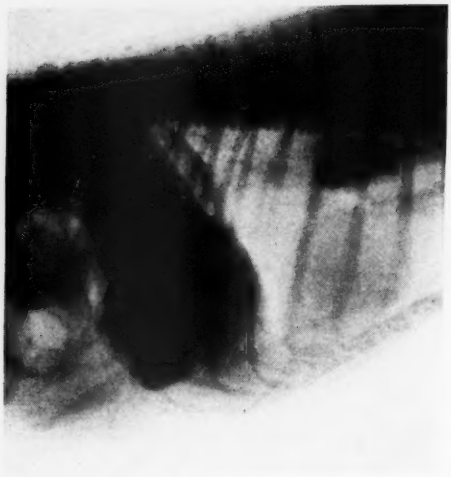
Radiography of fractures constitutes perhaps the most important phase of veterinary radiology. While not essential to the diagnosis of complete fractures, the x-ray is absolutely essential to proper treatment. In human medicine, the surgeon is considered negligent unless he uses the x-ray in treating a fracture case. Radiographs of fracture settings should always be taken in two planes. The greatest value of the x-ray lies in its ability to prove correct setting and to show early callus without disturbing the splintage. In healing fractures, the radiograph may show a disappointing lack of calicification even when the callus is functionally solid. A reduction in milliamperage or in tube current is necessary to bring out the soft callus which comes early in healing fractures. Periosteal callus may be seen as early as eight or ten days in the very young and healthy dog, but endosteal callus seldom is radiographically present before the 18th day of healing.

The Chest

Radiographs of the dog's chest are not as clear or as informative as those of the human because the shape of the chest does not lend itself kindly to dorsoventral radiography. While the lateral view outlines the heart well, illuminates the aorta, and may show neoplasms in the lung, it is to be faulted for its inability to show inflammatory lesions clearly. However, the lateral view is best for the illustration of foreign bodies in the thoracic esophagus or in the trachea. For lung or other chest disease, the dog should be placed on its back with the median plane of the dog in the same plane as the tube so as to give a symmetrical view of both sides of the chest. To aid in doing this, an aluminum trough made of two sheets of the metal one-fiftieth of an inch thick is used. This trough forms a rest for the dog's back and the casette is slipped beneath it in a slot designed for the purpose. Films are exposed at an optimum time of one-twentieth to one-thirtieth of a second. If the power of the apparatus used is inadequate for such exposures, then it should be operated at full power and the exposure made in just sufficient time to penetrate the chest. In chest disease, an additional film should be made with the dog standing to show "fluid level" of serum or pus in the chest or confined within abscess walls.



Radiograph of thorax of a dog showing No. 6 shot imbedded in the lung and in the heart. The oblong shadows are made by movement of the lead pellets which are synchronous with the movements of the lungs and heart respectively. Observed through the fluoroscope the effect was striking. The pellets appeared to be vibrating, the one in the lung somewhat slowly, the one in the heart rapidly.—*Photo by B. E. Foote.*



Radiograph showing a bone lodged in the esophagus. *—Photo by E. R. Blamey.*

The dog should be forced to stop breathing in all chest and abdominal films by holding one hand over the nose tightly in the conscious dog, or by applying digital pressure to the pharynx in the anesthetized animal.

The Stomach and Esophagus

Since the stomach lies mostly on the left side, the dog is placed on this side for radiography. For localization of foreign bodies or in any detailed study, the stomach is first taken without any opaque substance. Then either bismuth or barium sulphate is used in liquid form to outline the stomach and any non-opaque material contained in it. Radiographs of the stomach can illustrate abnormal size as seen in dilatation due to sympathetic irritation, abnormal position as seen in diaphragmatic hernia, foreign bodies which vary from razor blades to rubber balls, or abnormal function such as rapid or delayed emptying. In diaphragmatic hernia, the stomach may not move into the chest, but sections of intestines are almost invariably seen forward of the diaphragmatic curve.

For the greatest value, studies of the esophagus and stomach should be made with the fluoroscope — having the animal preferably in a standing position. An assistant should administer the opaque material while the operator watches its passage through the esophagus and into the stomach and from there through the pylorus and into the duodenum.

Non-opaque esophageal foreign bodies such as fish-bones in cats may be shown by the "bismuth-wash" method which consists of giving the animal a few swallows of milk of bismuth followed by a few swallows of water. The radiograph, made immediately, shows the opaque material clinging to the foreign body.

Kidneys

Retrograde pyelography cannot be accomplished in the male dog and although it is possible in the bitch, it seems too laborious to be practical for the veterinarian. It is much simpler to demonstrate the kidneys and ureters by the use of an intravenous iodide such as diodrast (Winthrop). The dog should be on its back and the bladder and rectum should be empty. Anesthesia in the form of nembutal may be given in combination with diodrast with perfect safety to the dog. The solution is injected into the vein, the children's dose of ten cubic centimeters sufficing for the average dog, and its passage through the kidneys is charted at seven, fifteen, twenty and thirty minutes. A cloth band is drawn tightly over the abdomen to minimize motion and to compress unwanted organs from the radiographic field. Hydronephosis may show a rounding of the calices or just a large sac filled with the opaque substance. Tumors may distort a calix or interfere with the excretion of the dye from one kidney so that a unilateral excretion is seen. It is important to remember that not all normal kidneys function with equal speed.

The Bladder

The bladder may be seen in the same position assumed for the kidney. The abdominal band should be drawn taut. Some calculi are difficult to demonstrate because of their non-opacity, their size, or the size of the host. In cats their size is the chief factor in making them difficult to locate. In this case the urine is drawn off and from

20 cubic centimeters, in a cat, to 200 in a large dog, of air is injected into the bladder via a catheter. With the catheter intact and stoppered, a radiograph is made. The air appears as a dark shadow and the calculi or new-growth stand out white in contrast Small polyps, large malignancies and calculi are the chief lesions found in the bladder of the dog or cat.

Intestines

Foreign bodies in the intestines are commonly diagnosed by radiography. A collection of a series of cases (unpublished) by the author of partial or complete intestinal obstruction fails to show uniform symptoms which would allow diagnosis without the radiograph. Sometimes the object may be palpated, but due to a variety of factors this method is unreliable in comparison to the x-ray. The completely obstructing foreign body causes a considerable collection of air anterior to the obstruction. Rubber, which is the most common cause of intestinal obstruction, is quite opaque. The hollow rubber ball is easily visualized by the even curve of displacement of gut contents. The solid rubber obstruction is visualized by its density. When sponge rubber has been swallowed, an opaque substance is used and it will be noted throughout the interstices of the spongy mass after passage of the other gut contents has taken place. Meat-flavored butcher's twine, or cloth such as silk stocking, can be identified by its retention of an opaque substance . On all abdominal films the compression band should be used to minimize motion.

The Abdomen

A lateral view of the abdomen shows a cross-section of the spleen and may facilitate diagnosis of splenomegaly. The rectum may be filled with barium to show constriction, dilatation, or herniation through its wall. Pregnancy may be diagnosed at six weeks, and the number and placement of the young noted. The skull shadow and the symmetrically-placed vertebræ are the identifying shadows to be looked for.

Pyometra may be diagnosed by the presence of confined fluid within a definite curved boundary.

Large masses indicating abdominal tumors may be shown by their density or by their displacement of other organs.

Summary

The use of the radiograph is recommended for veterinarians in place of fluoroscopy because of radiation dangers of the latter and greater accuracy of the former.

Accuracy and uniformity of placement of the patient is stressed for radiography of all parts of the body in order to be able to interpret correctly the results. The head is radiographed for fractures, foreign bodies, bone injuries or infection, while the neck is taken for soft tissue detail chiefly. The shoulder joint must be pulled free of the neck and chest to show proper detail and the vertebral column is necessarily taken in two planes. The pelvis is taken in the position of a man standing to show the hip joints to best advantage. Various degrees of congenital subluxation and dislocation have been diagnosed when this position has been used.

Rickets, osteogenesis imperfecta and malignant tumors, chiefly carcinoma and various osteogenic sarcomas, have been diagnosed in long bones by their invasive character.

Chest films are made flat on the dog's back, or standing for disease of the lungs or pleura, and lateral for tumors or cardiac lesions. Opaque material in the form of barium or bismuth is used in the stomach and fluoroscopy is recommended in the study of this organ and of the esophagus. Intravenous iodides are used to show the kidneys and air is injected via a catheter for visualization of the bladder. A compression band in the form of a sheet of cloth is stretched taut over the abdomen when films are made to minimize motion and exclude unwanted organs from the field.

Pregnancy is diagnosed by the skulls and vertebræ of the young. Pyometra is diagnosed by the presence of confined fluid within a definite curved boundary, and abdominal tumors are visualized through their density or their displacement of other organs.

Zephiran—A New Germicide*

By CHARLES E. FANSLAU, Orange, New Jersey

THE study of antiseptics and germicides precedes our generation by nine centuries. During the 11th century the Arabians attempted to prevent the invasion of virulent organisms through breaks in the skin by applying dressings saturated in rose oil and wine to wounds. Wines were used to sterilize wounds by the Italian surgeons of the 13th century.

The theories of Lister were preceded 300 years by Würtz, who advocated the protection of wounds by dressings. During the three centuries which followed, investigators studied the influence of air on wounds and methods of preventing and counteracting putrefaction. In veterinary medicine too bandages were used, in prehistoric days, to prevent the contamination of wounds as is told in the Veterinary Military History of United States (P. 151).

But to Semmelweiss, Pasteur, and Lister in the 19th century we owe the foundation of antiseptic procedure and principle. Today we no longer fear infections as did our professional progenitors, but neither do we resort to irritating agents such as carbolic acid to prevent them.

From the research conducted in the light of Lister's theories we expect with justification that an antiseptic be non-irritating as well as germicidal.

■ After years of diligent study such an antiseptic with rather unique properties was developed, and on an entirely new chemical basis. It is called zephiran and contains no phenol, iodine, mercury, or other heavy metals. According to results of several investigations (Dunn, Massachusetts Institute of Technology; Deskowitz, Thompson, College of Physicians and Surgeons, Columbia University and others) zephiran has been shown to be superior in bactericidal action to compounds containing these substances. Zephiran is a mixture of high molecular alkyl-dimethyl-benzyl-ammonium chlorides. The high molecular residue is composed of alkyl radicals ranging from C_8H_{17} to C_{18} H_{37}. The source of these radicals is a mixture of fatty acids of coconut oil. Zephiran is freely soluble in water and forms a clear almost odorless solution. In aqueous solution it is slightly alkaline to litmus.

■ It has been shown that the efficiency of an antiseptic solution is increased as the surface tension is reduced; because preparations with low surface tension have greater penetrative powers and the antiseptic disperses more readily into pores and crevices of skin which may harbor mircoorganisms. Because of the low surface tension and approximately neutral *p*H of zephiran it affords deep penetrability without injury to the tissues involved. Its detergent action removes dead epidermis and encrustations leaving a smooth, aseptic surface.

Even in low concentration zephiran exerts a powerful antiseptic and germicidal action on bacteria. As shown by tests carried out in conformity with the methods accepted by the U. S. Food and Drug Administration, the powerful germicidal action of zephiran, as distinguished from its antiseptic and bacteriostatic activity, was repeatedly confirmed by research bacteriologists for a variety of species of bacteria and higher fungi, and was shown to be most striking on virulent organisms pathogenic to man.

The action of various popular antiseptics commonly used was tested against *Staphylococcus aureus* and *Escherichia coli*. In the instance of *S. aureus*, it was found that zephiran aqueous solution 1:1000 may be diluted 35 times and still destroy the organism in less than 10 minutes. It is interesting to note that the usable concentrations of several mercurial antiseptics failed to destroy the test organism within 15 min-

*Presented at the 32nd Annual Meeting of the Georgia State Veterinary Association, June 20, 1938.

utes. Although the complex mercurials are highly effective bacteriostatic agents, they are relatively ineffective in their germicidal or killing power on pathogenic organisms.

Zephiran was found to remain unchanged after several years of storage at room temperature. Further tests of stability were performed by freezing and storing it in dry ice. Phenol coefficient determinations proved that there is no loss in efficiency. Storage at a temperature of 50°C. over a period of weeks also caused no apparent loss in efficiency.

■ In toxicity studies it was found that zephiran aqueous solution 1:1000 can be given by mouth to guinea pigs as their only source of fluid for months without harmful effect upon the health. A 1:1000 solution injected intraperitoneally (up to 6cc) daily for several months caused no reaction. Further studies indicate that rabbits tolerate 1.2cc per kilogram of body weight of the 10% solution when given subcutaneously or intraperitoneally.

■ The non-irritating quality of zephiran on body cells is further demonstrated by the fact that wet compresses may be applied to the skin without deleterious effect. Pads of saturated gauze were affixed to shaved areas of rabbits' ears and held in place for 24 hours. Ten times the recommended clinical concentration showed only minimal irritation. When this concentration was applied repeatedly to the skin and allowed to dry, no irritation was observed.

The many types of exacting tests in which zephiran has demonstrated its high efficiency recommend it for a variety of uses. It is eminently useful for preoperative preparation of skin and mucous membranes. The tinted solution when applied to the skin, clearly defines the outline of the operative field. For the disinfection of unbroken skin an alcoholic solution of 1:1000 is suggested. For deep wounds, the quick sterilization of instruments, and for the sterilization of mucous membranes the aqueous solution is recommended. For denuded and highly sensitive skin or mucous membranes, aqueous dilutions of 1:2000 to 1:5000 are desirable.

An extensive bibliography consisting of 60 published papers on zephiran comprises the most recent chapter in the volumes on bactericides.

* * * *

Livestock Remedy Frauds

The State Board of Agriculture has as one of its many duties the enforcement of the Kansas Live Stock Remedy Law, which was enacted because of the fraud and misrepresentation practiced in the sale of such products. Not only does this statute provide that the manufacturer must state on the label the name of each ingredient, and the percentage of certain poisonous ingredients, but prohibits the use of any advertising which is false as to the curative or therapeutic effects of the product. This statutory control over the advertising has eliminated a number of products from the market in Kansas. Quite often an application is received for a product claimed to be a cure for hog cholera, for sleeping sickness of horses, or for some other disease or diseases for which no known drug or combination of drugs is effective as a cure. Needless to say, these applications are rejected, and so far as our knowledge is concerned such products are not being offered for sale in Kansas at this time.

It is natural that when we were having the epidemic of sleeping sickness of horses, that certain individuals should take advantage of the situation and peddle a preparation which they claimed to be a curative for this disease. Almost any farmer who has a valuable horse sick with this disease is tempted to try any concoction recommended as a cure at a cost of only a few dollars. However, these few dollars of which the farmer is defrauded are not the only undesirable consequence as the time lost waiting for results which will not materialize may forestall any success with recognized treatment.

One preparation being sold for the cure of sleeping sickness of horses was composed of alum and water. Not only were the farmers who had purchased this paying an exorbitant price for alum and water, but the preparation could not produce the results for which it was sold. Complaint was filed against this man and upon entering a plea of guilty he was assessed a fine and costs.

Just recently the secretary of the Board of Agriculture under authority vested in him by the live stock remedy law cancelled the registrations of two products after testimony was offered at a hearing indicating that the manufacturer was making false claims for his products, and recommended to the county attorney that complaint be filed.

Until some proprietary preparation is recognized by veterinary authorities as a cure, it is advisable not to waste time and money on such concoctions. —*Paul Ijams*, Topeka, Kans.

New Food Law Big Improvement Over Old

The new Federal Food, Drug and Cosmetic Act, is a great step forward in the protection of the American public. It broadens the scope of the old law and, in many respects, reinforces those provisions which have stood the test of time.

Important respects in which the measure differs from the present law are:

(1) The new law has jurisdiction over all cosmetics except toilet soaps.

(2) Brings therapeutic devices, as for example electric belts, under control.

(3) Regulates drugs intended for diagnosing illness or for remedying underweight or overweight, or otherwise affecting bodily structure or function.

(4) Requires adequate testing of new drugs for safety before they are put on the market. The "elixir" of sulfanilamide which caused the death of nearly 100 persons last year emphasized dramatically the need for this provision.

(5) Provides for the promulgation of definitions and standards for foods.

(6) Increases penalties for violations.

(7) Provides authority for the Federal courts to restrain violations by injunction.

(8) Eliminates the necessity for proving fraudulent intent in the labels of patent medicines. Under the new law any such medicine proved to be worthless may be removed from the market.

(9) Requires drugs intended for use by man to bear labels warning against habit formation if they contain any of a list of narcotic or hypnotic habit-forming substances, or any dervative of any such substance which possesses the same properties.

(10) Requires the labels of non-official drugs (those not listed in the pharmacopoeias and formulary) to list the names of the active ingredients, and in addition to show the quantity or proportion of certain specified substances.

* * * *

Future research in animal breeding may be centered on stimulating ovulation by the use of hormones so that many females may be presented simultaneously for artificial insemination from one male.

* * * *

Humane Society's Calendar

Friends of J. A. Campbell, Toronto, were as usual pleasantly surprised this year by the attractiveness and individuality of the yearly calendar published by The Toronto Humane Society. Each page contains a large picture of one or more animal pets, most of them accompanied by child companions. The pictures are particularly well chosen.

"Takes" in Fowl Pox Vaccination

In vaccination for the prevention of fowl pox, examination for "takes" should be made five to seven days after vaccination. Definite swelling of the follicles or the entire vaccination area without scab formation is characteristic of a satisfactory pigeon virus "take." Unless 80% of the flock shows a good "take," revaccination should be considered. In appraising "takes" it is sometimes advisable to pluck feathers from the thighs of two to three birds in the usual manner, without applying vaccine, in order that vaccine reaction may be compared with folliculitis due to feather removal. The unvaccinated or control birds may be vaccinated at the time the flock is examined for "takes."—*C. A. Brandly.*

* * * *

Cow's Milk Low in Vitamin D

Wallis and Olson, of the Dairy Department, South Dakota State College, have recently published data on the seasonal variation in the vitamin D content of milk as ordinarily produced. Six Holstein cows were studied, and bioassays were made of composite samples of the butter fat obtained at three different times in the year, with the following results: April milk, 8 U.S.P. units per quart; July milk, 32 units per quart; November milk, 9 units per quart.

Various other workers, who have studied the vitamin D content of normal milk, have reported values, which, when expressed in terms of U.S.P. units per quart, range from 3.1 for winter milk to 43 for summer milk.

The Council on Foods of the American Medical Association has stated that milk with 135 U.S.P. units per quart will usually prevent rickets, when fed to normal infants in customary quantities, but that milk with 400 units per quart provides a margin of safety. Quoting this statement, Wallis and Olson say, "On this basis, it is evident that even summer milk, containing 32 units per quart, is not potent enough to be used as the only source of vitamin D for infants."—*Vitamin D Milk.*

Canine Pediatrics

IX. Regimen for Artificial Feeding of Very Young Puppies*

By D. M. CAMPBELL,
Chicago, Illinois

SUCCESS in the artificial feeding of very young puppies depends first upon a suitable simulated bitch's milk, second upon the quantities of this artificial bitch's milk that are fed and third upon the management and frequency of the feedings.

The purpose of this article is to outline for the veterinary practitioners an efficacious feeding regimen, which in the final analysis is the foundation of the practice of canine pediatrics.

The regimen herein recommended represents a synthesis of abstract principles of nutrition science, especially as applied to the feeding of the new-born, established through the decades, and of empirical studies made on hundreds of puppies, beginning with biological research wherein feeding of puppies was incidental to obtaining comparative data in the development of improved feeding for human infants, and culminating in a long series of investigations with development of a successful method of feeding young puppies as the sole objective.

In arriving at this recommended feeding regimen the values and defects of all previously practiced feeding schedules were tested and of virtually every possible combination or variation of known methods. The philosophy of feeding heretofore has been to offer and insist upon puppies taking food at two- to three-hour intervals. In the experience of the Borden research workers in developing a simulated bitch's milk this practice proved to be fallacious and undesirable. Awakening puppies every two or three hours for feeding not only deprived them of proper rest but it also overtaxed their digestive capacities. Two- or three-hour intervals, results indicated, did not permit adequate time for complete digestion and assimilation of feedings or for the necessary rehabilitating processes of the immature tissue and vital organs of the young pup. Furthermore, such practice overtaxed secretory sources of digestive juices. Just as human infants require rest as well as complete emptying of the stomach between feedings, so, too, puppies must have suitable intervals between feedings for proper assimilation and utilization of the dietary.

WITH correct total daily food intake established in accordance with caloric and fluid requirements determined as outlined in the preceding article, the frequency, and consequently the level, of individual feedings were arrived at through many and prolonged feeding tests involving studies of growth rates, fecal conditions and organic response.

Three feedings a day, at eight-hour intervals, proved to be the optimum schedule. It eliminated excessive regurgitation, resulted in improved assimilation and utilization, allowed the puppies an abundance of rest, did not overtax the organs, was accompanied by better fecal conditions, and in terms of growth and physiological well-being afforded the best nutrition. Since experience in puppy feeding, as in ordinary practice, is the criterion by which the value of the materials and methods used must be judged, in the final analysis this experience completely negatives theoretical dicta to the contrary—even theories based upon observations of natural feeding.

This feeding regimen, as well as being nutritionally most satisfactory for the puppy, has the additional, practical advantage of reducing the tedious and expensive task of preparing and administering eight to twelve feedings a day on a two- to three-hour schedule.

*Prepared in collaboration with Dr. G. C. Supplee and Mr. J. H. Le Ware, Borden Research Laboratories, Bainbridge N. Y. This is the ninth articles in a series on the nutrition of young puppies. The tenth installment will appear next month.

A detailed schedule for the feeding of young puppies of all weights on the simulated bitch's milk developed in this research is given in Table III.

Feedings scheduled in the table are based upon the caloric and fluid requirements per pound of body weight per day and are applicable, both to puppies taken directly from the bitch at birth and to puppies weaned abruptly or gradually from the mother.

The schedule is *not* applicable to the feeding of puppies recovering from severe diarrhea brought on by intestinal infection or by dysfunctioning of the gastrointestinal mechanism. If a puppy shows loss of appetite or develops an excessive amount of feces or abnormal condition of the feces, one of the feedings should be eliminated by substitution of an equal amount of water (sterile) for the artificial bitch's milk, and, of course, proper therapeutic measures should be taken also. In the case of the gradually weaned puppy the formula feedings should not be forced. Permit the puppy to take only as much as desired, but in no case *more* than is indicated in Table III. As the puppy is deprived of more of its mother's milk, it will take gradually increasing amounts of the formula until the standard level is reached, at which time suckling may be discontinued.

SINCE in the majority of instances, the weaning of puppies normally will be brought about by gradual instead of by abrupt separation of the animals from their mothers, as practiced in the experimental studies discussed in the preceding article in this series, it is appropriate to record a weaning schedule which has proved to be highly satisfactory and most adaptable for bringing puppies to the change from the entire bitch's milk diet to an entire artificial diet. This transition is accomplished best by removing the puppies from the mother for an entire 24-hour period except for two half-hour intervals spaced eight hours apart. During these two half-hour periods the puppies are allowed to suckle for approximately 20 to 30 minutes. At the third half-hour period, that is 24 hours after they were first taken from the mother, they are offered the simulated formula, and are allowed to take as much as desired, but not in excess of the proper amount per feeding as shown in Table III. This routine is repeated for the second 24-hour period. Beginning with the third 24-hour period the puppies are allowed only one 30-minute suckling period with the mother and are kept away from her the rest of the time. At the end of the two remaining 8-hour intervals, the simulated bitch's milk formula is offered and an intake not in excess of the proper level indicated in Table III is allowed. This routine is repeated during the succeeding 24-hour period, namely through the fourth day from the time the puppies were first taken from the mother. On the fifth day and thereafter the puppies are kept from their mother entirely and are provided the simulated bitch's milk at three regular 8-hour intervals each day. In following this weaning practice it is highly important that the feeding periods not only be approximately 8 hours apart, but that the respective periods be at the same times of the day, each day according to the clock.

Puppies which have become accustomed to random suckling periods may, for a short time after weaning, awaken and cry between scheduled feedings. They become accustomed to regular intervals between feedings rapidly, however, and the spacing of feedings tends to make them eager for the artificial milk and to increase the vigor of their feeding.

THE feeding schedule shown in Table III provides an intake of 60 to 70 calories per pound of body weight per day for the first two weeks. This level minimizes danger of digestive upsets during the puppy's period of adaptation to a new food, assures maximum tolerance of the formula, and provides for a controlled rate of growth and development.

After the initial two weeks, the caloric level is increased to 70 to 80 calories per pound of body weight during the third week, 80 to 90 calories the fourth week and 90 to 100 the fifth week. During the fifth week it is suggested that a finely ground, well-balanced dry dog ration be

TABLE III—PUPPY FEEDING SCHEDULE

TOTAL QUANTITIES PER 24-HOUR PERIOD, 1/3 OF TOTAL TO BE FED THREE TIMES DAILY AT 8-HOUR INTERVALS

Quantities of measure are expressed in the metric system. Grams or cubic contimeters may be converted to ounces by weight by dividing by 28.3. One level teaspoonful of dry powder is equivalent to 1.5 grams. One teaspoonful of sterilized fluid (24% solids) is equivalent to 5cc. For puppies weighing over one pound the formula may be calculated by using the one pound weight requirements and adding the additional requirements as called for on the ounce basis.

DURING 1st AND 2nd WEEK ON FORMULA							
Weight of puppy	130gm	180gm	240gm	300gm	350gm	410gm	453gm
When using dry powder							
Amount of powder	3gm	4.5gm	5.5gm	7.5gm	8.5gm	10gm	11gm
Amount of water	29cc	35.0cc	42cc	49cc	56cc	63cc	71cc
When using sterilized fluid— 24% solids							
Amt. 24% solids fluid	13cc	19cc	25cc	33cc	38cc	42cc	46cc
Amt. of water	20cc	21cc	23cc	24cc	28cc	31cc	36cc
Amount of formula as prepared per feeding	11cc	13cc	16cc	19cc	22cc	24cc	27cc
Total calories per day	60-70	60-70	60-70	60-70	60-70	60-70	60-70

DURING 3rd WEEK ON FORMULA							
Weight of puppy	130gm	180gm	240gm	300gm	350gm	410gm	453gm
When using dry powder							
Amount of powder	3.5gm	5gm	6gm	8gm	9gm	10.5gm	12.0gm
Amount of water	29cc	35cc	42cc	49cc	56cc	63.0cc	70.0cc
When using sterilized fluid— 24% solids							
Amt. 24% solids fluid	15cc	21cc	27cc	35cc	40cc	44cc	50cc
Amt. of water	18cc	19cc	21cv	22cc	26cc	29cc	32cc
Amount of formula as prepared per feeding	11cc	13cc	16cc	19cc	22cc	24cc	27cc
Total calories per day	70-80	70-80	70-80	70-80	70-80	70-80	70-80

DURING 4th WEEK ON FORMULA							
Weight of puppy	130gm	180gm	240gm	300gm	350gm	410gm	453gm
When using dry powder							
Amount of powder	4.12gm	5.62gm	8gm	9.75gm	11.25gm	13gm	14gm
Amount of water	29.00cc	35.00cc	42cc	49.00cc	56.00cc	63cc	70cc
When using sterilized fluid— 24% solids							
Amt. 24% solids fluid	18cc	24cc	33cc	41cc	47cc	54cc	59cc
Amount of water	15cc	16cc	17cc	18cc	21cc	23cc	25cc
Amount of formula as prepared per feeding	11cc	13cc	17cc	20cc	23cc	26cc	28cc
Total calories per day	80-90	80-90	80-90	80-90	80-90	80-90	80-90

DURING 5th WEEK ON FORMULA							
Weight of puppy	130gm	180gm	240gm	300gm	350gm	410gm	453gm
When using dry powder							
Amount of powder	4.5gm	6.75gm	9.75gm	12gm	13.5gm	15gm	16.5gm
Amount of water	29.0cc	35.00cc	42.00cc	49cc	56.0cc	63cc	70.0cc
When using sterilized fluid— 24% solids							
Amt. 24% solids fluid	23cc	31cc	40cc	48cc	56cc	63cc	69cc
Amt. of water	10cc	11cc	12cc	13cc	14cc	15cc	17cc
Amount of formula as prepared per feeding	11cc	14cc	17cc	20cc	23cc	26cc	29cc
Total calories per day	90-100	90-100	90-100	90-100	90-100	90-100	90-100

added to the ration in amounts of 1½ level teaspoonfuls to each 2½ ounces of the milk formula, or about ½ teaspoonful per feeding. In many instances this addition of solid food may be initiated during the fourth week and in exceptional cases even a few days earlier if the puppy has learned to lap his food. As the puppy becomes accustomed to the solid food the amount of dry food should be increased by ¼ teaspoonful at intervals of four or five days.

THE following directions are recommended for mixing the simulated bitch's milk formula when the supplement is in dry form. (If the simulated bitch's milk is purchased in sterilized evaporated fluid state containing approximately 24% solids and 76% water, mix the formula for feeding as shown in the alternative schedule of Table III.)

1. Determine amounts of water and simulated bitch's milk powder required by weighing the puppy and consulting the feeding schedule.

2. Warm the water to blood heat (100°F.) and measure the required amount of a good grade of potable water into a suitable container.

3. Dip a teaspoon into powder, pack firmly with knife and level off the powder with edge of knife.

4. Place the required number of leveled teaspoonfuls of powder on top of water.

5. Stir briskly with an egg beater or with a fork or spoon until the powder is thoroughly dissolved.

6. Do not prepare more of the formula than is required for a 24-hour period. If more feed is prepared than is required for single feeding keep the remainder under refrigeration. If an entire day's formula is prepared it may be divided equally into three parts and each part fed every eight hours, or it may be put into a single container from which one-third of total may be removed from each of three findings.

The following feeding directions are recommended:

1. Warm the formula mixture to approximate body temperature (100°F.) of the puppy before feeding.

2. Feed very young puppies from a bottle with nipple. Any type of bottle that will take a nipple satisfactorily and that may be cleaned readily will serve for feeding purposes.

3. The Standard infant-feeding nipples are suitable for larger breeds of puppies but smaller breeds, such as the cocker spaniel, require a smaller nipple and it is suggested that for such breeds a regular puppy nipple be provided.

4. Care should be taken that the holes in the nipple are not too large, in which case the milk will flow too easily and may cause choking and flow out through the nasal channels. The stream of milk should be sufficiently small so that the puppy has to suck with some vigor and so that the feeding period is prolonged.

5. Exercise care in holding the bottle so that at no time is the puppy permitted to ingest air with its food. If this occurs the puppy may regurgitate in an effort to expel the air from the stomach. If the air is retained it may cause the puppy pain.

6. Puppies fed the formula from birth or after a few days on the bitch should be taught to lap the food from a dish, and the bottle should be discarded after a period of four to five weeks and before any solid food is added to the ration. Teaching the puppy to lap is a tedious and sloppy procedure in the beginning and care must be taken that it receives the full food intake provided in the feeding schedule. It is remarkable, however, how rapidly puppies learn to lap their food. It has proved an effective practice for the one who feeds the puppy to wet the little finger of one hand with some of the formula and while the pup is sucking to draw its mouth gently to the dish, holding the head with the other fingers of that hand, and holding the paws with the other hand. Exciting the puppy or forcing must be avoided in this procedure. Within two or three days puppies usually learn to stand before their dishes and lap the food in a most satisfactory manner.

A MICROBE or a virus knows no discrimination between species, and puppies are as subject to intestinal infection

as are human infants. Reasonable cleanliness and proper sanitary conditions, therefore, should prevail throughout the preparation of the puppy formula, during the feeding procedure, and in the care of utensils and feeding equipment. After each feeding, bottles, nipples and other utensils should be washed thoroughly in hot, soapy water and rinsed in warm water.

THE foregoing feeding regimen is presented as applicable for very young puppies—under six to eight weeks of age. After pups have learned to lap and to eat semi-solid foods, the amount of ground dry food added to the feedings should be increased. By the time the puppy has reached the age of about seven to eight weeks the amount of dry food added should be such that the feeding mixture is of a mushy consistency. It is important to the development of the digestive system of the puppy that adequate bulk be provided in semi-solid form by this time. After the puppy has taken the mushy mixture for a few days a quantity of finely ground lean meat of about the size of a hickory nut should be well mixed with each feeding.

As a final precaution, it is advised that, particularly during the first one or two weeks, the feeder should make no effort to accelerate an already satisfactory rate of growth and development, accompanied by a normal fecal condition, by feeding excessive amounts or concentrations of the simulated bitch's milk formula. Any rapid changes in concentration, or any amounts in excess of those prescribed for the various body weights will result in complications often difficult to arrest. Continuation of such practice will lead to disastrous results.

THE degree of success that may be attained in maintaining a uniform rate of growth and development of very young puppies by proper feeding of a satisfactory simulated bitch's milk is well exemplified in the accompanying Charts XVIII to XXI inclusive.

These charts represent typical cases from different litters and involving different breeds. The practically continuous uniform growth rate exhibited by each of the pups charted, through a suckling period of nine days or 19 days, gradual or abrupt weaning, and establishment of the artificial milk formula, with subsequent introduction of solid food, is considered to represent, from a practical point of view, an achievement in the practice of canine pediatrics which would be difficult to duplicate regularly from a natural suckling of normal bitch's milk throughout a similar period of observation. These results were obtained under conditions wherein not only was the formula artificially prepared and fed, but wherein

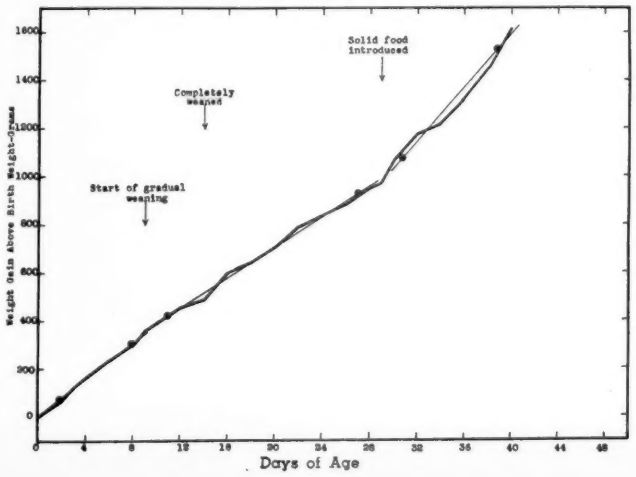


CHART XVIII

The sustained growth rate of the puppy whose curve is charted at the left was the result of properly-managed feedings of suitable artificial feeding formula. The puppy was weaned gradually to simulated bitch's milk from the 9th to 13th days. Solid food was added to the diet on the 29th day.

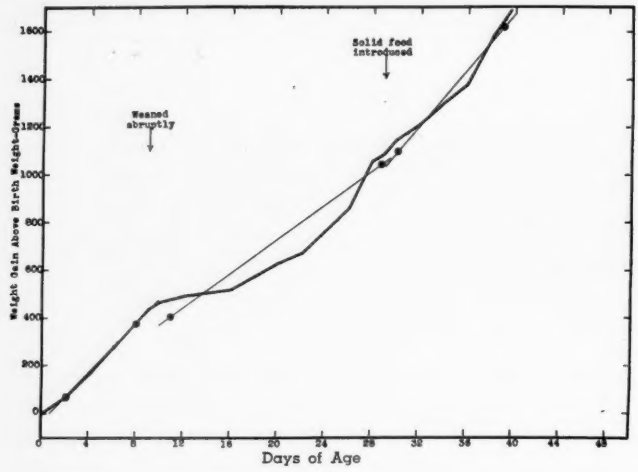


CHART XIX

Although this puppy was weaned abruptly rather than gradually, at nine days of age, remarkably satisfactory growth was obtained by correct management of the artificial feeding and introduction of solid food after the 29th day.

all other features of management and care of the pups also were of a totally artificial nature in contradistinction to the motherly care and environment to which the pup would be subjected if allowed to remain with its mother until the final period of weaning to solid food.

While it is apparent that the outstanding result of this artificial regimen is the progressive normal development and growth of the pup, the actual growth curves from day to day during and following the transition from one food to another are also worthy of note and comment. Detailed inspection of these growth charts shows that even under the very satisfactory general conditions of progress illustrated, there is evidence of the effect of the changed dietary. This is apparent in the gradual and abrupt weaning procedures wherein for a period of a few days there is a slackening of the growth rate and a readaptation to the new dietary. It is considered of significance, however, that this concrete evidence of change in dietary as reflected in the absolute continuity of the previously established growth rate, is, on the whole, substantially of no different character or order of magnitude irrespective of whether the weaning period was at nine days of age or 19 days

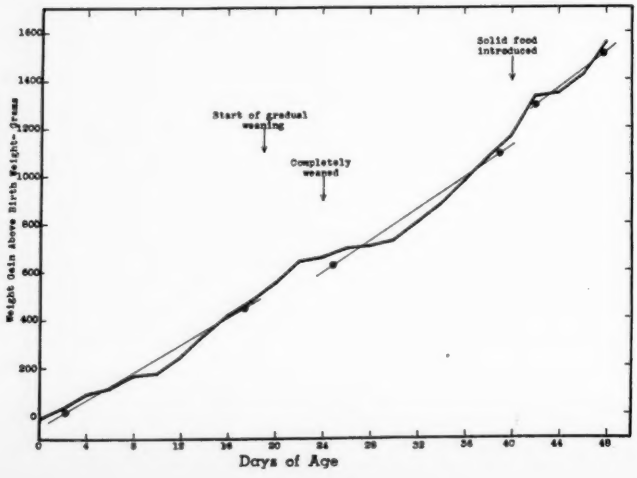
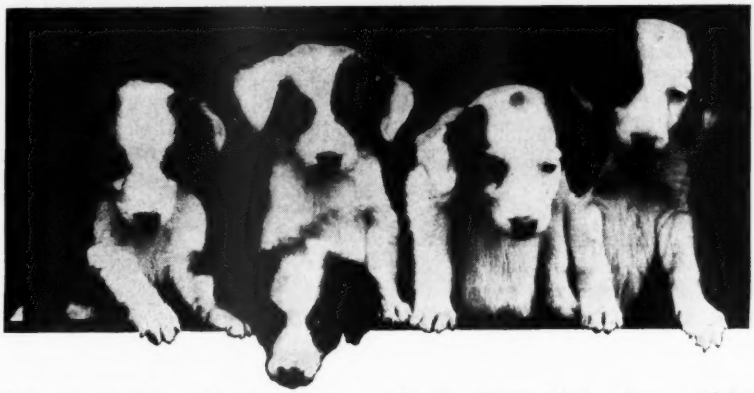


CHART XX

After gradual weaning, completed between the 19th and 24th days, this puppy gained weight more satisfactorily during the well-controlled artificial feeding regimen than during its 18 days of suckling, as shown by the straight line statistical graphs superimposed on the growth curve.

of age. While it may be accepted as an axiom that the younger the animal the greater the problems involved in weaning and reëstablishment on an artificial dietary, the achievement being predicated, first, upon the development and production of a satisfactory and compatible formula involving the various considerations pre-



the fact that the simulated bitch's milk has been used successfully on young pups taken from the mother immediately after birth seems to be sufficient evidence of the compatibility of the particular formula in question. This is further confirmed by the regularity of the progressive growth and development of the pups weaned after a preliminary suckling period, slight irregularity viously discussed in these articles, next, upon the determination of an appropriate feeding regimen based on caloric and fluid requirements and most suitable feeding intervals, and finally upon the physical management of a very young pup entirely separated from its mother with such attention to fundamental hygienic practices as experience has dictated as necessary. Cer-

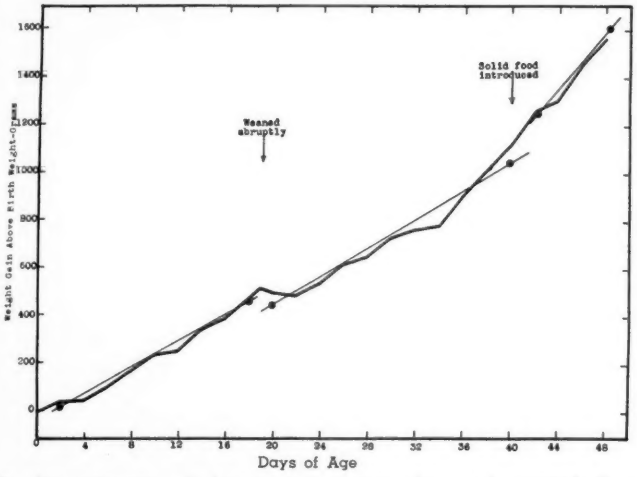


CHART XXI

The satisfactory transitions from 18 days of suckling, followed by abrupt weaning, to simulated bitch's milk, to a diet including both the artificial milk and solid food, were accomplished in the case of this puppy by a feeding schedule planned to obtain optimum growth as explained in the text of the accompanying article.

in the progress of the growth curves for the first few days notwithstanding.

Such evidence, typical of numerous instances, illustrates the progress which has been made in the field of canine pediatrics, tain practical aspects of these latter considerations which have proved to be highly valuable in the artificial care of young pups will be discussed in a future article in this series.

Abstracts

The Role of Veterinary Service in Modern Warfare

"The next great war will undoubtedly be decided, as was the World War, upon one factor, i. e., which side has the most efficient animal transport."

With the foregoing prediction, which is supported by quotations from various high military authorities, McKim[13] combats the impetuous desire of present-day military strategists for completely mechanized military forces, stating that in Ethiopia 70,000 mules were used to transport divisional artillery after motors had proved useless on that terrain and that 10,000 camels were used in the lowlands in that campaign.

In discussing the Spanish Civil War the author states:

A force of 30,000 with tanks and armored cars moved swiftly along the roads toward the instantaneous success of the Fascist theory. When government troops and artillery moved out at Guadalajara to meet this force and deployed from the main road to fight, immediately the motility of the attacking forces vanished. Its mechanized vehicles entangled with each other in the mud, presenting targets rather than an attacking army. When an attempt at retreat was made, the roads choked, and planes diving overhead slaughtered the motorized army almost as they pleased.

Of the present war in China it is stated: "The more recent experience of the mechanized forces of Japan in the invasion of China, gives plenty of food for good, sober thought. The Japanese staff planned to take Shanghai in two weeks, but 88 days elapsed before this objective was achieved, and then after animal transport was brought in to carry on from the point where mechanization stalled."

A veterinary corps in an army is visioned as a conservation service, important for the loss it prevents in military animals by disease control and fostering good animal management and for the animal casualties that it salvages. Its conservation of food is also of importance. In addition it conserves the health of the command through its food inspection service, thus preventing the use of unwholesome food.

McKim would change the organization of the Veterinary Corps in the United States army, taking the veterinary service for animals away from corps, divisions, and regiments and attaching a veterinary regiment to the equivalent of each type army to supply veterinary service as needed to its component corps and divisions.

[13] McKim, Orville E., 1938. The Rôle of Veterinary Service in Modern Warfare. *The Military Surgeon,* 83:5.

* * * *

Vaccination Against Bang's Disease

In an experiment carried on in 1932-34 at the U. S. Department of Agriculture Experiment Station, Bethesda, Md., six calves about six months of age and five yearling heifers were vaccinated against Bang's disease.[11] When pregnant, these animals and 12 unvaccinated pregnant heifers were exposed to *Brucella abortus* through the conjunctiva or by contact with infected animals.

The exposure failed to transmit Bang's disease to any of the vaccinated animals, as indicated by guinea-pig-inoculation results with uterine material and colostrum at time of calving.

The five animals vaccinated during calfhood that produced vigorous calves gave negative results to the agglutination test at time of calving. On the other hand, three of the animals vaccinated when yearlings reacted in a titer of 1:100 and the fourth in a titer of 1:200 when they produced their calves.

Close contact for 24-hour periods at different times with five cows that had recently aborted resulted in the transmission of Bang's disease to three of seven, or 43 percent, of the pregnant heifers used as controls. A single conjunctival exposure transmitted it to four of five, or 80 percent, of the control animals used.

The use of abortion vaccine in calves

[11] Buck, J. M., and W. E. Cotton, 1938. Vaccination of Calves and Yearlings against Bang's Disease. U. S. Dept. of Agr. Tech. Bul. No. 658.

gives indication of having a distinct advantage over its use in more mature unbred heifers since in the former the *Br. abortus* agglutinins that are caused to appear in the blood serum by the vaccine injections disappear more promptly and more regularly. The vaccine used was made from B.A.I. "Strain 19."

* * * *

Dysentery of New-Born Lambs

It has been recognized for many years that lambs, in common with the young of other species of domestic animals, may develop a fatal, acute dysentery in the first few days of life.[12] While "white scours" of calves has been studied quite extensively, there are few records in the literature of investigations of the etiology of the similar condition which occurs in lambs.

In the northwestern United States, since early lambing in sheds has become a general practice, heavy losses from dysentery in new-born lambs have occurred. In Montana these losses were first brought to the attention of the veterinary authorities in 1927. In 1927 and 1928, field investigations were made on several ranches, and bacteriological examinations were made of material from lambs dying of dysentery. In 1929 intensive experimental work on this disease was undertaken at the Montana Veterinary Research Laboratory. This study has been continued through six lambing seasons, and a large amount of data has been accumulated, from which formulation of certain conclusions as to the etiology of the disease seems to be justified.

The clinical picture in all the outbreaks investigated has been practically the same. The lambs appear normal during the first day of life. The symptoms of the disease first appear between 20 and 36 hours after birth in the great majority of cases, and nearly all cases develop within 48 hours of birth. In the lambs which recover, the duration of the acute symptoms varies from one to three days as a rule. In the fatal cases, death may occur from a few hours to three days after the symptoms first appear. In most cases the first symptom noticed is the development of diarrhea, the fecal material at this stage being semi-solid and yellow. Later, the lambs appear depressed and show little interest in nursing. They stand with back arched and ears and tail drooping. The diarrhea usually becomes more profuse, and the typical discharge consists of a thin, gray, fetid fluid. In the fatal cases this stage is usually reached within 12 hours after the first symptoms appear. In these cases the lambs lie down most of the time. Attempts at defecation are accompanied with evidence of pain. In some cases the discharges are blood-stained. After a few hours the lamb becomes prostrated, and death occurs in most fatal cases within 24 to 36 hours of the first appearance of symptoms. A small percentage of acute cases end fatally within six hours, and in some of these cases prostration occurs without the development of diarrhea.

The conclusions reached as a result of this research over a six-year period are:

1. Dysentery of new-born lambs, as it occurs in the northwestern United States, is the resultant of several factors rather than a specific infectious disease caused by a specific pathogenic micro-organism. Those factors are: low temperatures, resulting in lowered vitality, or resistance, of the lambs; unsanitary conditions of lambing sheds and corrals, resulting in the ingestion during the first day of the life of the lamb of a relatively large number of bacteria in filth; and the presence in the environment of strains of intestinal bacteria which are potentially pathogenic.

2. The bacteria directly involved are the usual species found in the intestinal tracts of normal lambs, usually *Escherichia communior* or closely related species, and more rarely, *Clostridium welchii.*

3. Attempts to control the disease by the use of anti-serums prepared by the use of *Escherichia* cultures recovered from lambs dead of dysentery have produced unsatisfactory results, although they have not been entirely without effect.

[12] Marsh, H., and E. A. Tunnicliff, 1938. Dysentery of New-Born Lambs. Mont. State Col. Agr. Exp. Sta. Bul. No. 361.

4. Treatment of affected lambs with intestinal antiseptics has been of some value when the treatment was started early. The losses have also been definitely reduced by the administration of an intestinal antiseptic (phenolsulphonates of zinc, calcium, and calcium and acriflavine) to all lambs born during a severe outbreak.

5. Fundamentally, the problem of the prevention of dysentery of new-born lambs is a sanitation problem.

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Coccidiosis of Poultry

Chickens, turkeys, geese, ducks, and guinea fowls are all subject to coccidiosis.[14] At least six species of coccidia live and multiply in the intestines of chickens. One species (*Eimeria tenella*) develops in the walls of the ceca and causes the cecal type of the disease in young chickens, a type that is often acute and fatal. The two species that lodge in the small intestines usually produce a chronic type of the disease, although occasionally they produce a severe acute form. These two species are *E. necatrix* and *E. maxima*. Three other species (*E. mitis, E. praecox, E. acervulina*) are capable of inducing mild inflammatory changes in the intestine, which are seldom accompanied by symptoms of illness.

Thus an outbreak of coccidiosis in poultry may be caused by a single species; or two or more species may be present as a mixed coccidiosis infection of the intestine and the ceca. Other strains may be present without causing any apparent illness.

Coccidia causing the intestinal or chronic form of the disease (*E. necatrix, E. maxima*) usually do not produce so many oöcysts as the cecal type (*E. tenella*). The rate of spread is less rapid, and the course of the disease tends to be less severe. Symptoms of chronic intestinal coccidiosis—unthriftiness, poor appetite, loss of flesh, paleness, poor or rough feathering, weakness and dullness—are often poorly defined and a specific disease is not always suspected. Often the symptoms of chronic coccidiosis cannot be distinguished from those caused by various infectious diseases of poultry or by internal or external parasites or dietary deficiencies.

Symptoms of the acute form of the disease, which is usually confined to young chickens, include bloody diarrhea, weakness, and paleness, accompanied by high mortality. In the chronic malady, which generally occurs in pullets or cockerels, varying degrees of unthriftiness are observed. Fowls affected with either type of the disease perpetuate the disease on the premises and are thus a constant threat to healthy stock.

Prompt application of control measures is highly important in the control of coccidiosis. Diagnosis should therefore be made as quickly as possible after any symptoms appear.

Like other parasitic and infectious diseases, coccidiosis of poultry is perpetuated by the passage of the disease agent from the infected host to the susceptible host. Coccidia passing from an infected fowl require favorable conditions outside the body for a short time (21 to 48 hours) to develop or ripen, and become infective. Consequently preventive measures based on management practices are effective in checking coccidiosis. Susceptible fowls must be protected against direct or indirect contact with exposed, infected, or recovered stock. All birds over three weeks of age not definitely known to be free from coccidia, or exposure thereto, should be considered potentially dangerous.

The number of coccidia which a bird swallows often determines the severity of the disease. Small numbers of the coccidia may be overcome but large numbers may lead to serious injury or death.

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Askew and Dixon of New Zealand found that two diseases of sheep in New Zealand —bush sickness and Morton Mains disease, are cured by cobalt, either as a drench or when mixed with salt. The salt mixture is prepared by spraying a ton of salt with four ounces of a solution of cobalt chloride in water. As a drench 4mg or 1/64gr. of cobalt in solution, is used.—*Exp. Station Rec.* 79:3.

[14] Graham, Robert, and C. A. Brandly, 1938. Coccidiosis of Poultry. U. of Ill. Agr. Exp. Sta., Circ. 485.

Book Review

SULFANILAMIDE THERAPY OF BACTERIAL INFECTIONS. *By Ralph R. Mellon,* M.D., Dr. P.H., D.Sc. (Hon.), Director, Institute of Pathology, The Western Pennsylvania Hospital, Pittsburgh; *Paul Gross,* M.D., Pathologist to the Institute; and *Frank B. Cooper,* M.S., Research Chemist to the Institute. Cloth bound. 386 pages, 16 figures. Charles C Thomas, Springfield, Ill., and Baltimore, Md., 1938. $4.00.

This is indeed a timely work. In addition to recording their own extensive research carried on continuously since the first use of sulfanilamide in this country (August 1936), the authors have compiled and briefed the findings of all other research workers in the field and the published accounts of clinical observations. The work is intended for physicians and medical students, but much of the information it contains is equally applicable to the work of veterinarians, the more so as most of the experimental work was of course carried out on animals.

The authors indicate the importance of this study by stating:

The successful employment of p-aminobenzenesulfonamide, now officially designated sulfanilamide, and to a lesser degree two other related organic compounds, in the treatment of diseases caused by diverse pathogenic microörganisms, particularly the hemolytic streptococci, constitutes the greatest advance in chemotherapy since the discovery of salvarsan. In the subsequent annals of medical history it may indeed come to rival this product as an alleviator of disease and human suffering. The likelihood of this consideration is based in part on the absence of a narrowly limited specificity of these drugs against a single infecting agent. On the other hand, one sees an unprecedented breadth of coverage against several infections, the limitations of which are at present by no means established.

And by the following prediction:

For the first time in the history of infectious disease we have a synthetic chemical compound that is therapeutically convincing in a bacterial infection in man. Even more surprising is the fact that this drug is already ripe with promise in respect to its effect on several infections. If and when this promise is fulfilled, we shall indeed have embarked upon a new epoch in the history of chemotherapy. For then the limits of specificity previously assumed will have been transcended in a degree for which no one dared even to hope. And the present experimental paradoxes associated with this unique behavior give added zest to the search for the underlying secret of the drug's dramatic clinical effects. . . .

Thus, if sulfanilamide only proves distinctly effective for these many types of hemolytic streptococci—for which separate antiserums were already being prepared by some—it will be as the airplane to the stage coach! And if it finally appears that the favorable action is not confined to this group, as an increasing number of studies already suggest, it will be more important than ever before to learn precisely in terms of biochemistry and pharmacology just how these startling effects come about. For only in this way can chemotherapy approach a rational basis, and its efforts become less groping in character. . . .

Indeed, if only a reasonable percentage of sulfanilamide's claims prove valid, an enormous advance will have been made.

After discussing the oral, subcutaneous, intramuscular, intravenous, intrathecal, intrapleural, rectal, and topical administration of these agents, the authors conclude:

. . . it appears that the oral administration of the drug has been definitely accepted as the method of choice because of its efficiency and simplicity. The subcutaneous method is indicated where parenteral medication is indicated in preference to other routes of administration. Intrathecal administration may possess distinct advantages as an adjuvant to the oral or subcutaneous methods in meningitis. Intravenous or intramuscular administration has no recognized advantage over the subcutaneous method.

Of toxic effects it is said:

Therapy with sulfonamide compounds is associated with a definite hazard of unfavorable collateral reactions, some of which, unless carefully watched and controlled, may become as serious as the primary disease. There have, however, been only 10 fatalities reported as associated with this form of therapy in approximately 4,000 cases [in man]. There appears at present no correlation between these reactions and dosage.

And again:

The sulfonamide compounds possess a relatively low toxicity for animals, and in the concentrations likely to be attained in animal tissues as a result of therapeutic dosage they are remarkably inert or at the most, feebly active pharmacologically.

. . . it is clear that the mandates of caution and safety preclude the administration of other drugs along with sulfanilamide—at

least until such time as it has been demonstrated what other drugs may be used with safety. At the present time, for example, we know that sodium bicarbonate, or sodium lactate, can be used with safety for the neutralization of the acidosis produced. . . .

In this connection it is worthy of note that special efforts have been made by those commercially interested in intravenous preparation. This may be viewed as another potential source of danger in addition to being quite unnecessary. Shock reactions are already known to have occurred as the result of intravenous administration of the sulfonamide compounds. One of the great desiderata of a chemotherapeutic agent is that it be capable of being used orally and this drug is a most noteworthy advance in this respect. The occasions when other modes of administration are required are exceptional; and continued attempts to encourage its intravenous employment can be construed only as one more index of the lengths to which certain agencies will go in their commercial exploitation of a first rate drug.

The Massengill "Elixir" should serve as an eternal notice that only properly qualified investigators are to be entrusted with matters of such vital import to the well being and the lives of the people.

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Super X-Ray Machine for Pennsylvania

One of the most important events to take place in the School of Veterinary Medicine, University of Pennsylvania, during the past year was the acquisition of a therapeutic x-ray machine capable of developing 220,000 volts. It was presented to the School at a cost of $6,500.00, plus $1,500.00 to train one of our staff in its operation, making a total of $8,000.00. It is the finest and most powerful apparatus for treating animals in this country, and probably in the world. In fact, only two other veterinary schools have such machines; one is in Vienna and the other in Prague. Several malignant growths in dogs have been cured by its use and it is hoped similar cases in other animals, as well as actinomycosis and other diseases in cattle may be cured likewise. The field for research and therapy is developing rapidly and will probably necessitate the establishment of a department of radiology in the School in the near future. We are pioneering in a new field in veterinary medicine.

A page of candid camera shots of Dean Ward Giltner of the Veterinary Division of Michigan State College enlivened the December issue of *Spartan*, the student publication of that college. The nine pictures, showing Dean Giltner in varying moods and postures during the course of a lecture, constitute an interesting cross-section of what the *Spartan* calls "the famous Giltner personality."

* * * *

There are at least 55,000 thoroughbreds in the country today, 26,000 standardbreds, 19,469 registered saddle horses, 5,000 horses of other pure breeds; and there are countless horses of mixed breeding—well over 150,000—used regularly for saddle purposes of various kinds.—*Horse and Horseman.*

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For injection under the skin or into a muscle or vein, only medicaments soluble in water with an alkaline or very slightly acid reaction, and which do not tend to form insoluble compounds with tissue or plasma constituents should, as a rule, be chosen.

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The year 1938 showed more advancement of veterinary knowledge in the horse field than any year in the past decade. Valuable study was made in three of the four main fields (nutrition, ophthalmia, sleeping sickness), showed decided gains in two (nutrition, sleeping sickness), proved of immediate benefit in one (sleeping sickness).—*Horse and Horseman.*

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In the past, the veterinarian was, in the entire State, the only scientific advisor in national breeding. Others are jealous of this rôle, but without reason. From his professional knowledge the veterinarian is the person best qualified to direct breeding and to lead it into ever new channels. All unprejudiced persons should recognize the preponderant role of the veterinarian in the breeding and utilization of animals.—*Valentin Stang,* in *Vet. Rec.,* 50:43.